SHOUT
SHARE
IT

N/H

SMITHSONIAN INSTITUTION
310735
AUG 2 1937
NATIONAL MUSEUM

BULLETINS

OF

AMERICAN PALEONTOLOGY

VOL. XXII

1935-1936

PALÆONTOLOGICAL RESEARCH INSTITUTION
FOUNDED 1932

Ithaca, New York

1936

75, 76

CONTENTS OF VOLUME XXII

Bulletin No.		Plate	Page
73	Pennsylvanian Ostracoda of the Ardmore Basin, Oklahoma .... By Herbert Henry Bradfield	1-13	1-185
74.	Seven new species of Foraminifera from the Tertiary of the Gulf Coast .... By Wade H. Hadley, Jr.	14	186-196
75.	The stratigraphy and paleontology of northwestern Pennsylvania. Part II: Paleontology . Section A: The Cephalopod fauna of the Conewango series of the upper Devonian in New York and Pennsylvania .... By R. H. Flower and K. E. Caster.	15-22	197-270
76.	Cherry Valley Cephalopods .... By Rousseau H. Flower.	23-31	271-361

1937

BULLETINS

OF

AMERICAN PALEONTOLOGY

Vol. 22

*

No. 73

Pennsylvanian Ostracoda of the Ardmore Basin. Oklahoma

By Herbert Henry Bradfield

January 11, 1935

PALEONTOLOGICAL RESEARCH INSTITUTION
FOUNDED 1932

Ithaca, New York,
U. S. A.

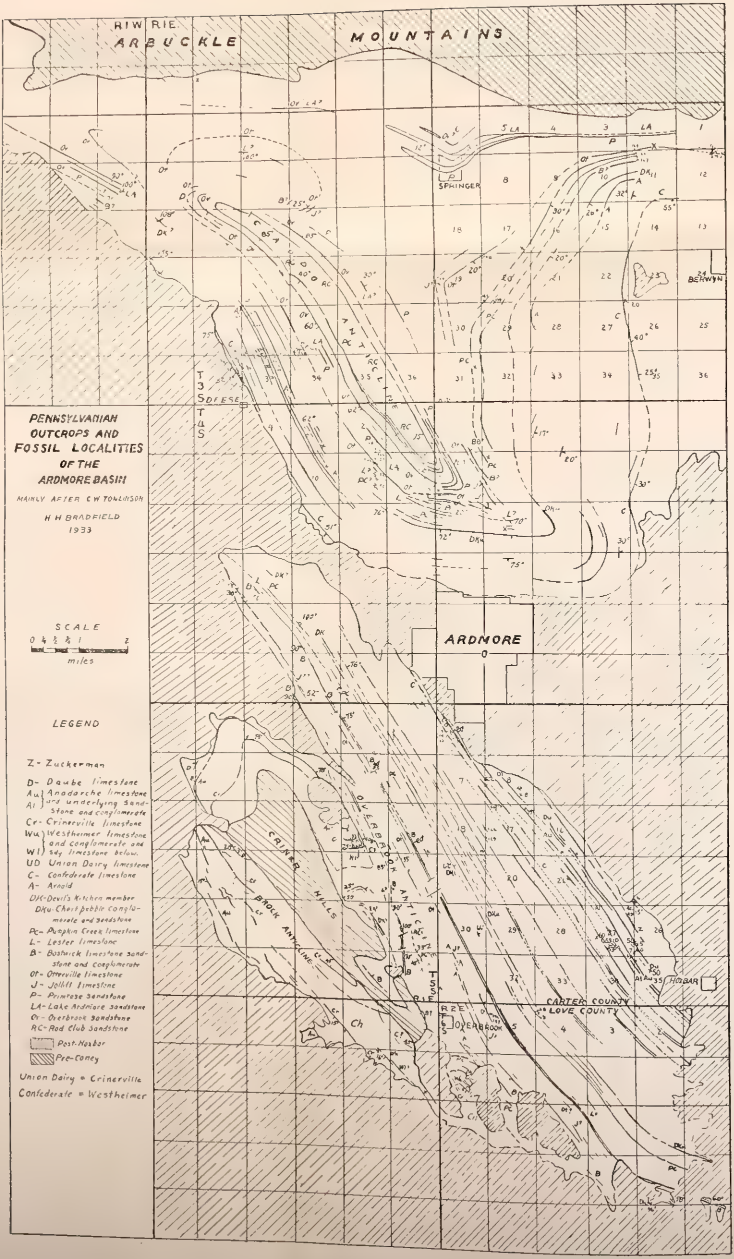

PENNSYLVANIAN OUTCROPS AND FOSSIL LOCALITIES OF THE ARDMORE BASIN
MAINLY AFTER C W TOMLINSON
H H BRADFIELD
1933
SCALE
0 ¼ ½ ¾ 1 2
miles
LEGEND
Z - Zuckerman
D - Daube limestone
Au } Anadarche limestone
Al } and underlying sandstone and conglomerate
Cr - Crinerville limestone
Wu } Westheimer limestone
Wl } and conglomerate and sdy limestone below.
UD Union Dairy limestone
C - Confederate limestone
A - Arnold
DK - Devil's Kitchen member
DKu - Chert pebble conglomerate and sandstone
Pc - Pumpkin Creek limestone
L - Lester limestone
B - Bostwick limestone sandstone and conglomerate
Ot - Otterville limestone
J - Jolliff limestone
P - Primrose sandstone
LA - Lake Ardmore sandstone
Or - Overbrook sandstone
RC - Rod Club sandstone
Post-Hoxbar
Pre-Coney
Union Dairy = Crinerville
Confederate = Westheimer
R1W R1E
ARBUCKLE MOUNTAINS
SPRINGER
BERWYN
T3S
T4S
DEESE
CADDO ANTICLINE
ARDMORE
OVERBROOK ANTICLINE
CRINER HILLS
BROCK ANTICLINE
T5S
R1E R2E
OVERBROOK
HOXBAR
CARTER COUNTY
LOVE COUNTY
Ch

Figure 1, Frontispiece

Submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the Department of Geology in the Graduate School of Indiana University, June, 1933

PENNSYLVANIAN OSTRACODA OF THE ARDMORE BASIN, OKLAHOMA

BY

HERBERT HENRY BRADFIELD

PAGE
INTRODUCTION 7
ACKNOWLEDGMENTS 9
STRATIGRAPHY 9
A. SPRINGER FORMATION 9
B. DORNICK HILLS FORMATION 11
Jolliff limestone (12); Otterville limestone (12); Bostwick member; Lester limestone (13); Pumpkin Creek limestone (13); Fauna (13)
C. DEESE FORMATION 13
Devil's Kitchen member (13); Arnold limestone (14); Confederate vs. chert conglomerate (14); Fauna (14)
D. HOXBAR FORMATION 16
Confederate-Westheimer member (16); Union Dairy-Crinerville member (17); Anadarche limestone (17); Daube limestone (18)
E. FAUNAL CHART 18
F. CORRELATION 21
ORIENTATION OF THE CARAPACE 22
SYSTEMATIC DESCRIPTIONS 29
FAMILY APARCHITIDAE Ulrich and Bassler 29
Genus **Paraparchites** Ulrich and Bassler 29
FAMILY PRIMITIIDAE Ulrich and Bassler 35
Genus **Coryellina,** n. gen. 35
Genus **Mammoides,** n. gen. 37
FAMILY KLOEDENELLIDAE Ulrich and Bassler 38
Genus **Jonesina** Ulrich and Bassler 38
Genus **Sansabella** Roundy 44
Genus **Kirkbyina** Ulrich and Bassler 45

Genus **Nuferella,** n. gen. 45
FAMILY BEYRICHIIDAE Jones 47
Genus **Hollinella** Coryell 47
Genus **Hollites** Coryell and Sample 49
FAMILY KIRKBYIDAE Ulrich and Bassler 49
Genus **Kirkbya** Jones 50
Genus **Ulrichia** Jones 53
Genus **Amphissites** Girty 54
Genus **Knightina** Kellett 64
Genus **Roundyella,** n. gen. 66
Genus **Scaberina,** n. gen. 67
FAMILY GYLPTOPLEURIDAE Girty 68
Genus **Glyptopleura** Girty 68
FAMILY YOUNGIELLIDAE Kellett 69
Genus **Moorea** Jones and Kirkby 70
Genus **Youngiella** Jones and Kirkby 72
Genus **Moorites** Coryell and Billings 73
FAMILY CYTHERIDAE Baird 73
Genus **Monoceratina** Roth 74
FAMILY BAIRDIIDAE Sars 78
Genus **Bairdia** McCoy 78
Genus **Bairdiacypris,** n. gen. 93
Genus **Bythocypris** Brady 93
Genus **Healdiacypris,** n. gen. 103
Genus **Waylandella** Coryell and Billings 103
Genus **Macrocypris** Brady 104
Genus **Healdia** Roundy 104
Genus **Seminolites** Coryell 115
Genus **Harltonella,** n. gen. 118
FAMILY CYTHERELLIDAE Sars 121
Genus **Cytherella** 122
Genus **Cavellina** Coryell 129
Genus **Sulcella** Coryell and Sample 134
Genus **Cavellinella,** n. gen. 136
OSTRACODA OF UNCERTAIN POSITION 137
Genus **Cyathus** Roth and Skinner 137
Genus **Ardmorea,** n. gen. 138
Genus **Schmidtella** Ulrich 139
New Genus? 140
Genus **Binodella,** n. gen. 140
REGISTER OF LOCALITIES 141

PENNSYLVANIAN OSTRACODA OF THE ARDMORE BASIN, OKLAHOMA

INTRODUCTION

The outcropping Pennsylvanian sediments of the Ardmore Basin occupy a strategic position between the exposures of Pennsylvanian age in central Oklahoma and rocks of similar age in Texas. Unfortunately the area is completely separated from both, and because of its isolation and the character of the sediments, correlation has been extremely difficult with units of similar age to the north and south.

The areas of Pennsylvanian exposure might be considered as occurring in very large inliers formed by the erosion and removal of younger Carboniferous and Early Cretaceous deposits. The exposures are terminated on the north by the Arbuckle uplift, on the south and east by the overlapping Lower Cretaceous, and on the west by overlapping late Permo-Carboniferous Red Beds. The exposed formations consist mainly of shales and sandstones, with a few relatively thin beds of limestone. Structurally the area may be divided into three parts, the north part, lying next to the Arbuckle Mountains, in which the main structural feature is the Caddo Anticline; the south part, lying adjacent to the Criner Hills, in which the Overbrook Anticline is located; and the middle part, the Ardmore Syncline, in which the town of Ardmore lies.

The area of outcrop is largely confined to Carter County, only two townships at the north edge of Love County having Pennsylvanian rocks exposed at the surface.

These sediments were discussed and mapped in a rather general way by Taff[1] who named the Caney shale, and called all the overlying Pennsylvanian the Glenn formation. Goldston[2] subdivided the Glenn formation into five members: from oldest to youngest, the Springer, Otterville, Cup Coral, Deese, and Hoxbar. Miser[3] on the geologic map of Oklahoma included the Springer with the Caney formation, and mapped that above as Glenn. The first detailed mapping of the area was by Tomlinson[4]. He carefully mapped all the resistant members, and quite successfully attempted the solution of their relations to one another. In very few cases did he err in the actual mapping of any of these beds, and what is still more remarkable, he came very close to the correct identification of the beds north of Ardmore with those on the south side of the syncline, using only lithology as the basis of correlation. Tomlinson raised the Springer, Deese, and Hoxbar members of Goldston to formational rank, and included Goldston's Otterville and Cup Coral members in a new formation, the Dornick Hills. In addition to this, Tomlinson named practically all of the limestone and sandstone members of any importance.

---

[1] Taff, J. A., Geol. Atlas U. S. Geol. Survey, folio 98, 1903; U. S. Geol. Survey, Prof. Paper 31, 1904.

[2] Goldston, W. L., Jr., Bull. Am. Assoc. Pet. Geol., vol. 6, pp. 5-23, 1922.

Girty and Roundy[5] have collected and identified several megafaunules from the Pennsylvanian of the Ardmore Basin. Harlton[6] described numerous Foraminifera and Ostracoda from this area, but without any attempt to indicate the exact horizon of their occurrence, or their ranges.

The purpose of the present paper is to give the results of a systematic study of the Ostracoda from these rocks, using great care to indicate the exact horizon of occurrence, and in so far as possible the range of each species. The last is a difficult problem. Great thicknesses of barren shales and sandy sediments occur in which hardly a fossil can be found, weathering has made fossils from many samples unidentifiable, and the extremely high folding has so crushed and lacerated the specimens that in many faunules only a small percentage of the species present can be safely identified. Continued sampling and study will no doubt add many species in the future, and contribute to the ranges of those already described. Most of the collecting was done by the writer in the years 1928 to 1931.

---

[3] Miser, H. D., Geologic Map of Oklahoma, 1927.

[4] Tomlinson, C. W., Okla. Geol. Surv., Bull. 46, 1929.

[5] Girty, Geo. H., and Roundy, P. V., Bull. Am. Assoc. Pet. Geol., vol. 8, pp. 331-349, 1923.

[6] Harlton, Jour. Pal., vol. 1, no. 3, pp. 203-212, 1927; Jour. Pal., vol. 2, no. 2, pp. 132-141, 1928.

ACKNOWLEDGMENTS

The writer wishes to make grateful acknowledgment to all those who have in any way aided in this research. Especially to Dr. M. P. White, of Ardmore, Oklahoma, for aid in collecting and for other valuable favors; to Dr. C. W. Tomlinson, of Ardmore, Oklahoma, for suggestions as to fossil localities and for the use of his maps; to Mr. R. W. Whiteside, Tulsa, Oklahoma, for material; to Prof. E. C. Case, and Prof. G. M. Ehlers, of the University of Michigan, for guiding research in the year 1929; to Dr. H. N. Coryell, of Columbia University, for examining many of the drawings and commenting on the identifications; and most of all, to Prof. J. J. Galloway and Prof. E. R. Cumings, of Indiana University, for valuable criticism and aid in completing the research and reading the manuscript.

Gratitude is also expressed to the Graduate Council of Indiana University for a University Fellowship during the year 1932-33.

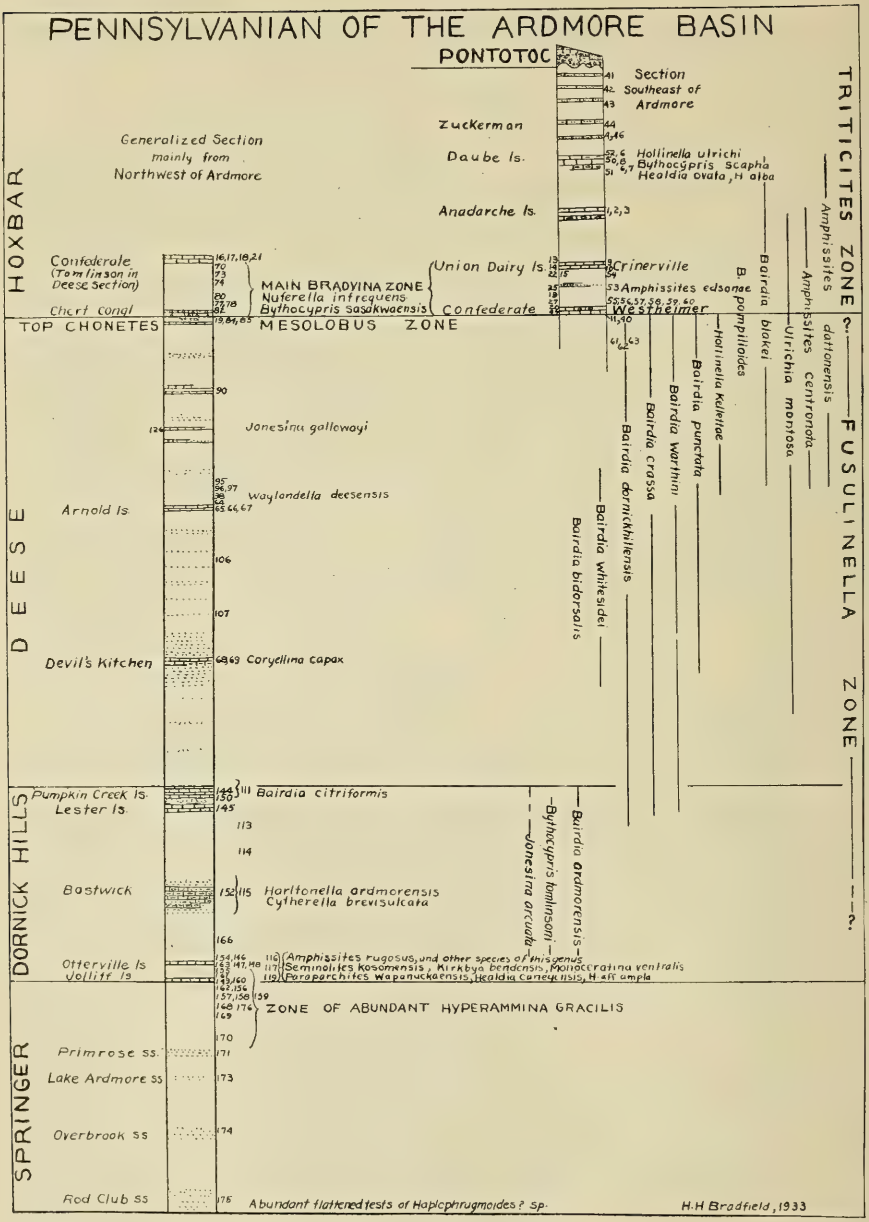
STRATIGRAPHY

The Pennsylvanian sediments of the Ardmore Basin are divided into five formations, which are, from the base upward, Springer, Dornick Hills, Deese, Hoxbar, and Pontotoc. The latter consists of conglomerates and Red Beds produced by the folding and erosion of the Arbuckle Mountain Region. These lie with marked unconformity upon not only the preceding Pennsylvanian but upon all rocks of Paleozoic age. Since they are for the most part unfossiliferous, and more closely related to the Red Beds above they will not be further considered in this paper.

SPRINGER FORMATION

This formation comprises 3,000 feet or more of black bituminous shales with ferruginous, calcareous, and ankeritic concretions alternating with four prominent sandstones. These sandstones, from the base upward, have been named by Tomlinson,

FIGURE 2


PENNSYLVANIAN OF THE ARDMORE BASIN
PONTOTOC
Section Southeast of Ardmore
Generalized Section mainly from Northwest of Ardmore
HOXBAR
DEESE
DORNICK HILLS
SPRINGER
Zuckerman
Daube ls.
Anadarche ls.
Hollinella ulrichi
Bythocypris scapha
Healdia ovata, H alba
Confederate (Tomlinson in Deese Section)
Chert congl
Union Dairy ls.
Confederate
Crinerville
Amphissites edsonae
Westheimer
MAIN BRADYINA ZONE
Nuferella infrequens
Bythocypris sasakwaensis
TOP CHONETES
MESOLOBUS ZONE
Jonesina gallowayi
Waylandella deesensis
Arnold ls
Devil's Kitchen
Coryellina capax
Pumpkin Creek ls.
Lester ls.
Bairdia citriformis
Bostwick
Harltonella ardmorensis
Cytherella brevisulcata
Otterville ls
Jolliff ls
Amphissites rugosus, and other species of this genus
Seminolites kosomensis, Kirkbya bendensis, Monoceratina ventralis
Paraparchites wapanuckaensis, Healdia caneyensis, H. aff ampla
ZONE OF ABUNDANT HYPERAMMINA GRACILIS
Primrose ss.
Lake Ardmore ss
Overbrook ss
Rod Club ss
Abundant flattened tests of Haplophragmoides? sp.
H.H Bradfield, 1933
TRITICITES ZONE ?
FUSULINELLA ZONE ?
Amphissites dattonensis
Amphissites centronota
Ulrichia montosa
Bairdia blakei
B. pompilioides
Hollinella kellettae
Bairdia punctata
Bairdia warthini
Bairdia crassa
Bairdia dornickhillensis
Bairdia whitesidei
Bairdia bidorsalis
Bairdia ardmorensis
Bythocypris tomlinsoni
Jonesina arcuata
41
42
43
44
45,46
52, 6
50, 8
51
6, 7
1, 2, 3
13
14
22
15
9
10
54
25
53
19
27
55, 56, 57, 58, 59, 60
11, 40
61
62
63
16, 17, 18, 21
70
73
74
80
77, 78
82
19, 84, 85
90
124
95
96, 97
98
64
65, 66, 67
106
107
68, 69
144
150
111
145
113
114
152
115
166
154, 146
163, 147, 148
116
117
119
149, 160
162, 156
157, 158
159
168
176
169
170
171
173
174
175

Rod Club, Overbrook, Lake Ardmore, and Primrose. The Rod Club is a sandy zone at the base of the Springer, and ranges in thickness from 250 feet to 400 feet. The thin shales interbedded in this sandy member contain tiny, flattened tests of *Haplophragmoides?* in great abundance. The shale must be boiled and washed until all of the silty material is removed, however, in order to see them. The Overbrook sandstone, a massive bed 45 to 100 feet in thickness, lies about 1,000 feet above the Rod Club. It is saturated with asphalt in the more northwesterly exposures. About 400 to 500 feet above the Overbrook is the Lake Ardmore sandstone, a small member only 15 to 20 feet thick. At this horizon molds of coiled cephalopods have been found. These are thought by Dr. Charles E. Decker, and Dr. Raymond C. Moore[7] to indicate earliest Morrow age. Megafossils are very rare in the Springer, although foraminifera are often very abundant. From 250 to 500 feet above the Lake Ardmore is the Primrose member. This is a zone of calcareous, hard, thin-bedded sandstone from 150 to 250 feet in thickness. The remaining 800 to 1,000 feet of shale constituting the upper part of the Springer formation contains abundant *Hyperammina gracilis* Waters, and other foraminifera similar to those in the Dornick Hills shales below the Otterville limestone. No megafossils have been found, but if found they should be like those of the Otterville and Jolliff limestones. Any ostracode fauna found in this interval should have a large number of species in common with the Otterville and Jolliff limestones.

DORNICK HILLS FORMATION

Deposition had apparently been continuous from Caney into Springer time. At the end of Springer time an uplift occurred in the region of the Criner Hills, which was probably contemporaneous with the elevation of the ancestral Wichitas. All of the Springer and Caney shales were removed, and the area was eroded deep into the older Palezoic limestones. Tomlinson has conclusively shown that this is the source of the Dornick Hill conglomerates.

---

[7] Tomlinson, C. W., Okla. Geol. Surv., Bull. 46, p. 14, 1929.

Jolliff limestone.—The lowest member of the Dornick Hills is the Jolliff. This was taken by Tomlinson as the base of this formation because it is the first limestone above the Mississippian Sycamore. It consists of 4 to 15 feet of conglomerate and fossiliferous limestone. The fauna of this limestone is much like that of the Otterville limestone above and the intervening shale.

Otterville limestone.—The next member of the Dornick Hills formation is the Otterville limestone. It is a thin-bedded, platy, ferruginous limestone, characteristically composed of pebbles, oolites, and shell fragments which are usually heavily coated with lime. The thickness varies from 10 to 70 (?) feet. The shale interval between the Otterville and Joliff is about 250 to 300 feet, north of Ardmore. According to Tomlinson the supposed Jolliff is 1,000 feet below the Otterville limestone in the northern part of Love County. Farther to the northwest the Jolliff disappears entirely, and there appears to be not more than 200 feet of shale below the Otterville before typical Springer is reached. This extraordinary thinning is not so astounding when one considers that the Dornick Hills formation as a whole has a thickness of about 4,000 feet in northern Love County, but is apparently not more than 1,000 feet thick at the west end of the Arbuckle Mountains. So great a thinning must mean that the source of the sediments was largely to the southeast in Llanoria, in spite of the heavy conglomerates derived from the Criner Hills. It is quite possible that the limestone occurring below the Otterville is not always the same bed, but a zone of potential limestones with local lentils developed from place to place. Any limestone occurring below the Otterville in the lower Dornick Hills or the upper part of the Springer would no doubt be similar in lithology and paleontology.

Bostwick member.—About 750 feet above the Otterville is the Bostwick member. It is a massive limestone conglomerate with the greatest development around the Criner Hills. The maximum thickness is around 300 feet. Tomlinson reports pebbles over 6 inches in diameter near the Criner Hills, but to the southeast the conglomerates grade into limestones, and to the north they grade into sandstone and finally disappear.

Lester limestone.—The next prominent limestone above the Bostwick member is the Lester limestone. The interval between the two is 400 to 500 feet north of Ardmore, but twice that at the south edge of Carter County.

Pumpkin Creek limestone.—The Pumpkin Creek limestone constitutes the upper part of the Dornick Hills, and consists of two or perhaps three distinct ledges. These, with perhaps the Lester in places, were Goldston's "Cup Coral member." The main Pumpkin Creek limestone is 900 to 1,000 feet above the Bostwick horizon north of Ardmore, and twice that in northern Love County.

Fauna.—The Dornick Hills formation has a large and varied fauna. Foraminifera, Bryozoa, brachiopods, gastropods, pelecypods, conodonts (?), and ostracodes are abundant. Among the latter there are many which are characteristic. *Paraparchites wapanuckaensis* Harlton and *P. ottervillicus* n. sp. are characteristic of the lower part, while P. *dornickhillicus* n. sp. is characteristic of both the middle and lower Dornick Hills. Species of *Monoceratina* are abundant in the lower part, but one species *M. dornickhillica* extends to the Bostwick horizon or above. *Jonesina arcuata* is a characteristic Dornick Hills form. *Kirkbya bendensis, K. jolliffana, Amphissites rugosus, A. marginiferus, A. cumingsi,* n. sp., *A. rothi* n. sp., *A. confluens* n. sp., *A. alticostatus* n. sp. are all characteristic of the lower part. *Bairdia ardmorensis* and *Bythocypris tomlinsoni* seem to be characteristic of the entire formation. The lower Dornick Hills ostracodes indicate a rather definite correlation with the lower Bend of Texas, and Wapanucka limestone and Johns Valley shale north and east of the Arbuckle Mountains.

DEESE FORMATION

This formation, 6,000 to 7,000 feet in thickness, consists mainly of gray and tan, often very sandy, shales and numerous impure sandstones. While there are numerous sandstones and thin limestones, only two are of sufficient importance to have been named.

Devil's Kitchen member.—About 1,000 feet above the top of the Dornick Hills is the Devil's Kitchen member. This consists of about 500 feet of massively bedded sandstones. It is comprised of two ledges, which south of Ardmore are separated by very fossiliferous limestone and calcareous shale.

Arnold limestone.—A little more than a third of the way below the top of the formation is the Arnold limestone. It is about 50 feet thick north of Ardmore and forms a conspicuous ridge, but south of Ardmore it is only doubtfully recognized. The extreme abundance of sponge spicules is the most characteristic feature of this limestone.

Confederate vs. *chert conglomerate.*—The top of the Deese formation has been taken at the base of the highest and most conspicuous limestone in the NE. ¼ sec. 32, T. 3S, R. 1E. This Tomlinson correlated as Confederate, which is the base of the Hoxbar formation south of Ardmore. The writer, however, believes that the chert conglomerate about 800 feet below this limestone is nearer the horizon of the true Confederate, and draws the top of the Deese formation at this point. This places the shale between the chert conglomerate and the "Confederate" in the Hoxbar formation where the faunal relationships indicate that it should belong. An additional factor in favor of the shortening of the Deese formation north of Ardmore is the matter of convergence. The Dornick Hills formation thins at least 2,000 feet from the northern part of Love County to the more north-westerly exposures of that formation. In the northeast part of T. 4 S., R. 1 E. Tomlinson has included 7,350 feet of sediments in the Deese, but only 6,700 feet 10 to 12 miles to the southeast on the Carter County-Love County line. And furthermore, from the NE. ¼ of T. 4 S., R. 1 E. to the SW. ¼ of T. 3 S., R. 1 E. the thinning is from 7,350 feet to about 5,000 feet. Not more than 1,500 feet can be assigned to the Deese in the oil fields thirty miles to the northwest.

Fauna.—The Deese on the whole is the most unfossiliferous of these formations. Where fossils are found they are usually in great abundance, but great thicknesses of sandy sediments occur in which hardly a fossil can be found. Continued diligent search may in time eliminate some of these gaps. In the lower two-thirds of the Deese only two horizons of any importance have been found by the writer. These are in the Devil's Kitchen member and near the Arnold. The preservation of the fossils in the Arnold and the crushing in the associated shales have very considerably lessened their value even there. On the whole, the Deese formation seems to be a faunal unit when the chert member is taken as the top north of Ardmore, and the Confederate limestone south of Ardmore. The top of the Deese is then the top of the *Chonetes mesolobus* and *Fusulinella* zones. The collection of Girty and Roundy (station 4050) which Tomlinson assigned to the uppermost Deese and possibly in part to the Confederate, is believed to be not from near the "Confederate" or highest limestone at that place but from near the chert conglomerate a little farther north. Several reasons can be advanced for this conclusion. The most abundant fauna occurs above and below the chert conglomerate and not at the limestone above. *Chonetes mesolobus,* which they reported in their collection, can be found abundantly just below the chert conglomerate but not above, and thirdly their location corresponds much better with the chert conglomerate than with the limestone above. Their description was "center west [meaning east] edge of sec. 32", T. 3 S., R. 1 E., but "about ¾ mile north of Deese, Okla." It is a short half mile to where the limestone crosses the road, but about three-quarters of a mile to the chert conglomerate and the fossiliferous beds.

Below this chert may be found *Chonetes mesolobus* and *Fusulinella.* Numerous species of *Bairdia* are found, which, although characteristic of the Deese may range down into the Pumpkin Creek limestone with some slight variation. *Bairdia punctata, B. dornickhillensis, B. crossa, B. warthini,* and *B. whitesidei* are among the most characteristic. The first occurs in the Confederate limestone also, but does not range so low as the next three, while the last one seems to be more characteristic of the middle two-thirds of the Deese. *Hillinella kellettae* occurs rather abundantly above the Arnold limestone. Abundant specimens of *Bradyina holdenvillensis* are found immediately below the chert conglomerate, but from there on down to the Arnold limestone they are very rare. They are abundant above in the lower Hoxbar, and will be discussed further in that connection.

HOXBAR FORMATION

This interesting formation has been the source of more stratigraphic difficulties than all the other formations combined. It is important because its numerous limestones and abundant fauna make it bear the brunt of upper Pennsylvanian inter-regional correlations. The stratigraphic difficulties have been largely disposed of by the elimination of 1200 feet of section including two limestone members from the lower Hoxbar. Stratigraphic duplication causing an apparent increase in thickness of a formation is a common thing in highly folded areas. Here the presence of the West Fork of Anadarche Creek obscured the stratigraphic relations so that Tomlinson identified the Confederate and Union Dairy limestones just south of Ardmore with two small limestone members in the upper part of the Deese formation, south of the West Fork of Anadarche Creek, and not with the Westheimer and Crinerville members above. The poor development of the Crinerville there was no doubt a contributing factor to the error. Tomlinson's sequence, therefore, was Confederate limestone, Union Dairy limestone, Westheimer limestone, Crinerville limestone, Anadarche limestone, Daube limestone, and Zuckerman member, whereas the true sequence is Confederate-Westheimer, Union Dairy-Crinerville, Anadarche, Daube, and Zuckerman. This greatly simplifies both local and regional correlations. So far as the writer is aware, Dr. Maynard White of Ardmore, from the study of fusulines, was the first to establish the identity of the Union Dairy with the Crinerville and to him should go the credit. Dr. C. W. Tomlinson, Mr. Morris Guthrey, and others are remapping the area in question, and in time a revised map will no doubt be published.

The Hoxbar formation, of which about 3,500 feet is exposed, consists of blue, tan, brown, and red shales alternating with thin limestones, which become quite sandy toward the top of the formation.

Confederate-Westheimer member.—This is a limestone and conglomerate which occurs at the base of the Hoxbar formation. It is relatively free from conglomerate just south of Ardmore, and contains a considerable fauna. Several species present are common to the Union Dairy also, but two species of *Cyathus?* and *Bythocypris sasakwaensis* seem to be characteristic of this limestone. The latter has been described only from the Sasakwa limestone.

Union Dairy-Crinerville member.—Four hundred to five hundred feet above the basal member are 10 to 30 feet of limestone, shaly limestone, and sandstone. This is very fossiliferous. *Bradyina holdenvillensis, Triticites,* and various species of *Textrataxis* are extremely abundant. Among the ostracodes *Paraparchites? ardmorensis, Scaberina nodomarginata, Moorites minutus, Bairdia pompiliodes, B. menardensis, B. blakei, B. bicornis, B. amygdaliformis, B. auricula, B. ciscoensis,* and *Bairdiacypris deloi,* seem to be the most characteristic.

In the shale between the Confederate-Westheimer and Union Dairy-Crinerville, and above the chert conglomerate north of Ardmore, ostracodes are extremely abundant. The species are far too numerous to list here, but on the faunal chart the Confederate-Union Dairy shale interval and the shale interval between the chert conglomerate and the "Confederate" north of Ardmore are distinguished, so that the proper location of a species may be readily seen. An interesting occurrence in this interval is the rare *Nuferella infrequens,* of which only two specimens have been found, one south of Ardmore, and an identical one north of Ardmore at almost exactly the same horizon. The occurrence together in at least three instances of the very similar but oppositely orientated *Kirbyina laevis* and *Sansabella whitei,* the great abundance of *Cytherella* aff. *gloria,* and the occurrence of the new genus *Mammoides* are worthy of note. Continued sampling in this interval should be rewarded by many more species.

In contrast to the shale just mentioned the shales between the Union Dairy-Crinerville and Anadarche have not furnished many species.

Anadarche limestone.—About 600 feet above the last member is the Anadarche limestone. At the base is a 10 foot bed of conglomerate, and at the top about 20 feet of dense, hard, bluish-gray limestone. Its fossils are usually not well preserved. It is characterized by the great abundance of *Ulrichia montosa, Amphissites dattonensis,* and *A. centronota,* the latter a very elongate variety.

Daube limestone.—Four hundred to six hundred feet above the Anadarche is a 10-foot limestone called the Daube. Immediately below this limestone is a bed of coal about four feet in thickness. This is the only coal known in the Ardmore Basin. The Daube carries abundant fusulines and other fossils. Abundant foraminifera of the ramose type are characteristic. *Bradyina holdenvillensis?* is found but it is not abundant and is usually in the triloculine stage. The *Bradyina holdenvillensis* of the Union Dairy limestone, and above and below the chert conglomerate northwest of Ardmore is very abundant, and much larger, often having five or six chambers in the last whorl, and showing a second row of apertures on the last chamber similar to those of *Bradyina magna* Roth and Skinner, from the McCoy formation of Colorado. The ostracodes which are characteristic of the Daube and adjacent shales are *Hollinella ulrichi. Jonesina daubeana, Amphissites dattonensis* (extremely abundant), *Bairdia longirostris, Bythocypris scapha. Healdia simplex H. humilis, H. nucleolata, H. ovata, H. alba, Cytherella daubeana, Cavellina laevissimus.*

The sandy limestone and shales above the Daube have yielded but few fossils. These consist mainly of high spired gastropods and tests of *Spirillina.*

FAUNAL CHART

The accompanying Faunal Chart shows the occurrence of the species described with reference to the resistent members. If a species occurs in the member or immediately above or below it is listed as coming from the member. If the symbol is placed between two members it indicates that the species occurs in that interval, but cannot usually indicate the number of samples in which it occurred or the exact relations to the members above or below. Poor preservation, due to weathering and mashing resulting from the high folding, coupled with the thick barren stretches of shale, have considerably detracted from the value of the tabulation as a range chart.

The symbols A, C, and R indicate Abundant, Common, and Rare; X indicates identification of poorly preserved specimens; ? indicates that the preservation is sufficiently good but the identification doubtful.

FAUNAL CHART

	HOXBAR						DEESE		DORNICK HILLS					SPRINGER
Ostracoda	Zuckerman	Daube ls.	Anadarche ls.	Union Dairy-Crinerville	Confederate-Westheimer	Chert conglomerate	Arnold ls.	Devil's Kitchen	Pumpkin Creek ls.	Lester	Bostwick, congl., ls.	Otterville ls.	Jolliff ls.	
Paraparchites wapanuckaensis												A A		
Paraparchites ottervillicus n.sp.												A A		
Paraparchites dornickhillicus n. sp.											A	C		
Paraparchites guthreyi n. sp.												C		
Paraparchites elongatus n. sp.												R		
Paraparchites brazoensis						C								
Paraparchites n. sp.				R										
Paraparchites harltoni							C							
Paraparchites ? ardmorensis n. sp.				C	C									
Paraparchites ? sp. undet.		R		R										
Monoceratina ventralis												A C	A	
Monoceratina dornickhillica n. sp.											A	A	A	
Monoceratina huddlei n. sp.												A C		
Monoceratina n. sp.						R								
Coryellina capax n. sp.								C						
Mammoides mammillata n. sp.						A								
Hollinella gibbosa						C								
Hollinella ulrichi	R	C												
Hollinella cf. pulchra							A C							
Hollinella Kellettae				R		X	C A							
Hollites ? sp.				R										
Jonesina arcuata											C	A C	A	
Jonesina gallowayi n. sp.							C							
Jonesina biformis n. sp.						A								
Jonesina hoxbarana n. sp.				A										
Jonesina gregaria						A A	X	R?						
Jonesina deesensis n. sp.						C								
Jonesina daubeana n. sp.		R												
Jonesina dubia n. sp.						R								
Jonesina trisulcata n. sp.							C							
Sansabella whitei n.sp.				A		A								
Kirkbyina laevis				A		A						A C	X	
Nuferella infrequens n. sp.				R		R								
Kirkbya bendensis												C C	X	
Kirkbya obliqua n. sp.				R										
Kirkbya jolliffana n. sp.												C	C	
Kirkbya cf. inornata												R		
Kirkbya n. sp.												R		
Ulrichia montosa			A	?	R		X	C						
Amphissites rugosus												C C	?	
Amphissites marginiferus												C	R	
Amphissites cumingsi n. sp.												C A		
Amphissites rothi n. sp.												C A	A	
Amphissites confluens n. sp.												C C		
Amphissites alticostatus n. sp.												C A		
Amphissites centronota			A	C C	R		A A							
Amphissites girtyi, var. deesensis n. var						A								
Amphissites pinguis				R		C								
Amphissites edsonae n. sp.				A										
Amphissites dattonensis	C	A	A	C C	C	C	C							
Knightina texana				C			A							
Knightina kellettae n. sp.												R		
Roundyella bellatula n. sp.												C		
Scaberina nodomarginata n. sp.				R										
Glyptopleura whitei n. sp.												C R		
Youngiella ? elongata				R?		C								
Youngiella ? convergens n. sp.						R								
Youngiella ? gracilia n. sp.						C								
Moorites minutus		C		C	R	A						R C		
Bairdia ardmorensis									C	X		A A		
Bairdia citriformis							?		A					
Bairdia dornickhillensis					?	A A	C	C	X	X				
Bairdia punctata n. sp.					C		A	C						
Bairdia hispida, var. lesterica n. var.										R R				
Bairdia biacuta n. sp.									C			X		
Bairdia bidorsalis n. sp.							X	C						
Bairdia oklahomaensis				C			X	X						
Bairdia pompilioides				C	C			?						
Bairdia hoxbarensis				R R										
Bairdia menardensis		R		C	C									
Bairdia blakei		C		C	C		C							
Bairdia crassa							C C	A	X					
Bairdia bicornis n. sp.				R										
Bairdia hispida var. alta n. var.				C										
Bairdia warthini n. sp.						X	C A	C	A					
Bairdia glennensis ?								R						
Bairdia whitesidei n. sp.							A	A						
Bairdia ignota n. sp.							C	X						
Bairdia amygdaliformis n. sp.				C										
Bairdia auricula				C	C		?							

FAUNAL CHART

	HOXBAR											DEESE					DORNICK HILLS									SPRINGER
Ostracoda	Zuckerman		Daube ls.		Anadarche ls.		Union Dairy-Crinerville		Confederate-Westheimer		Chert conglomerate		Arnold ls.		Devil's Kitchen		Pumpkin Creek ls.		Lester		Bostwick, congl., ls.		Otterville ls.		Jolliff ls.	
Bairdia lunata n. sp.								R																		
Bairdia ciscoensis							A	X	A																	
Bairdia longirostris n. sp.			C									?														
Bythocypris tomlinsoni																		A			?		X	C		
Bythocypris simillima n. sp.												X C														
Bythocypris deeseensis n. sp.												R														
Bythocypris angularis n. sp.								X				C														
Bythocypris sasakwaensis									A				?													
Bythocypris cooki n. sp.										C A																
Bythocypris scapha			A							C																
Bythocypris irregularis n. sp.										C																
Bythocypris frivola n. sp.										X A																
Bythocypris pediformis								C																		
Bythocypris parallela								R																		
Bythocypris subreniformis n. sp.							C																			
Bythocypris subpediformis n. sp.								C				C														
Bythocypris mytiliformis n. sp.			R																							
Bythocypris hoxbarana n. sp.			C					C																		
Bairdiacypris deloi n. sp.							C																			
Waylandella deesensis n. sp.												C														
Macrocypris delicatula n. sp.								R																		
Healdiacypris perplexa n. sp.								?		C A																
Healdia aff. ampla																								A		
Healdia caneyensis																								A	C	X
Healdia sp.																							A	A	A	
Healdia oblonga n. sp.												A														
Healdia aff. bythocyproidea												A														
Healdia cara n. sp.										R																
Healdia formosa										A																
Healdia bovicornis n. sp.										A																
Healdia deesensis n. sp.										C																
Healdia ? arca n. sp.										C																
Healdia angulata n. sp.										A																
Healdia ehlerei n. sp.										C																
Healdia simplex			A					A				A	?		C									?		
Healdia cuneiformis n. sp.								R																		
Healdia cf. glennensis								C		C																
Healdia ciscoensis							R	C		C?																
Healdia humilis n. sp.			A					A																		
Healdia nucleolata			C					A																		
Healdia ovata n. sp.			A																							
Healdia alba			C																							
Seminolites aff. truncatus Coryell										A																
Seminolites aff. elongatus Coryell										A																
Seminolites healdoides n. sp.										A																
Seminolites kosomensis Harlton																							C	C		
Seminolites pushmatahensis Harlton																							C	A	C	
Harltonella ardmorensis n. sp.																					A		R	C	?	
Harltonella macropleura n. sp.																								R		
Harltonella elongata n. sp.																								C		
Harltonella robusta n. sp.																								R		
Cytherella jolliffana n. sp.																									A	
Cytherella berwynensis n. sp.																									C	
Cytherella ottervillica n. sp.																							A			
Cytherella ottervillica, var. obesa n. var.																							A			
Cytherella ? brevisulcata n. sp.																					C					
Cytherella brevis n. sp.																							C			
Cytherella cavellinoides n. sp.										C																
Cytherella laevis n. sp.								C																		
Cytherella lirata n. sp.		R																								
Cytherella daubeana n. sp.			C																							
Cytherella gloria								A																		
Cytherella gloria var. alta n. var.								C																		
Cytherella longia Coryell & Sample								R																		
Cavellina robusta n. sp.																									A	
Cavellina subpulchella												C														
Cavellina minuta n. sp.										A																
Cavellina bisecta n. sp.																							R			
Cavellina pulchella Coryell												C														
Cavellina aff. pulchella Coryell								C																		
Cavellina expansa n. sp.								R																		
Cavellina polita n. sp.								C																		
Cavellina laevissima n. sp.		A	A	A																						
Cavellina sp.		C	C		C			C																		
Sulcella harrisi n. sp.								C													C					
Cavellinella casei n. sp.																							C		R	

CORRELATION

Faunistic studies of the Pennsylvanian formations north of the Arbuckle Mountains and in Texas are insufficient at the present time to permit detailed correlations on the basis of ostracodes alone, although the broader relations can be readily seen.

In Texas the principal studies have been made by Harlton on the Canyon ostracodes from Menard County, Coryell and Sample on the ostracodes of the East Mountain shale, Mineral Wells, and Coryell and Billings on the ostracodes of the Wayand shale, Cisco group. From north of the Arbuckle Mountains Warthin has published the Micropaleontology of the Holdenville, Wewoka, and Wetumka formations, while from east of the Arbuckle Mountains we have Harlton's recent study of the Johns Valley shale.

In the lower Pennsylvanian rather definite faunal relations are apparent. The lower Dornick Hills, from the Otterville to the Joliff, including both limestones, correlates with the Marble Falls of Texas, the Wapanucka limestone, and Johns Valley shale north and east of the Arbuckle Mountains. This indicates that the Springer, at least in part, may be equivalent to the Barnett shale of Texas, and the upper Caney north of the Arbuckle Mountains. For the upper Dornick Hills and lower Deese, stratigraphic relations are by no means apparent, mainly because there are no published faunas from that part of the section. This represents the stratigraphic column north of the Arbuckle from the Atoka formation to the Calvin sandstone, and in Texas, the Smithwick and part of the Strawn.

From middle to upper Pennsylvanian relations again become more apparent. The top of the *Chonetes mesolobus* zone and *Fusulinella* zone seems to be approximately the same. This is at or near the top of the Deese formation south of Ardmore, and at the chert conglomerate north of Ardmore. This corresponds to some point near the middle of the Holdenville formation north of the Arbuckle Mountains, and in Texas, to some point near the middle of the Mineral Wells. Further evidence in support of this correlation is the abundance of *Bythocypris sasakwaensis* in the Confederate limestone. Warthin lists this ostracode from the Sasakwa limestone only. Furthermore the Homer limestone contains *Fusulinella* and *Chonetes mesolobus* and should fall in the upper part of the Deese; and may well be represented by some of the thin limestones in that part of the section. The abundance of *Bradyina holdenvillensis* in the upper Deese and lower Hoxbar also checks this correlation. The great abundance of *Bradyina* and the similarity of ostracodes in the Union Dairy to those in the Confederate might suggest the correlation of those two limestones with the Sasakwa and Homer, except that the Confederate seems to be definitely out of the *Fusulinella* and *Chonetes mesolobus* zone, while the Homer is definitely within it.

With the elimination of two limestones from the lower Hoxbar, and 1,200 feet of section the correlation with the Canyon group is greatly simplified. Students of fusulines prefer to correlate the Anadarche with the Palo Pinto, and the Daube with the Adams Branch; but, from other faunal considerations the writer would like to see the Union Dairy-Crinerville included in the base of the Canyon. The Canyon would no doubt include the major portion of exposed Hoxbar, but it seems likely that the blue, sandy shale in the upper part of the exposed Hoxbar, and covered Hoxbar, represents the lower, or blue half of the Cisco. The upper, or red Cisco is without doubt to be correlated with the Pontotoc, which here lies with great unconformity upon the older Pennsylvanian.

ORIENTATION OF THE CARAPACE

The question of orientation of the valves of Ostracoda has been a problem for all students of Paleozoic forms. The matter is important because the entire description depends upon the decision as to which is the anterior and which the posterior end of the carapace.

Since the work of Ulrich and Bassler has very largely been the foundation of subsequent descriptions of Ostracoda in this country it follows that the more recent writers have very generally used their methods of orientation. Ulrich and Bassler[8] recognized that the rule used by Jones and other authors, namely that of regarding the thicker or blunter end as the posterior, proved much oftener true to nature than misleading. Their studies of the more complexly lobed Beyrichiacea, however, lead them to believe that these Paleozoic Ostracoda differed radically from Recent forms, and therefore that the rule of Jones could not be applied. After correlating from species to species and genus to genus the elaborate development of lobes and sulci of these forms, they[9] laid down the following criteria for orientation: (1) the relative width, position and direction of the median furrow or sulcus which was found to be wider than either the anterior or the posterior sulcus, to lie almost always more or less behind the mid-length of the valves, and which when prolonged ventrally was found to curve more or less backward: (2) the correlation and identification of the median and posterior lobes, both of which lie behind the median sulcus and usually are distinctly separated by the posterior sulcus though occasionally completely confluent, as in *Ctenobolbina ciliata;* (3) the outline of the valves, particularly in straight-hinged forms, which commonly are more or less oblique and widest behind, with a backward swing from the hinge; an outline which suggests a parallelogram rather than an oblong figure; (4) the location of the brood pouch, which obviously should be associated with the posterior half of the carapace and which is fact always lies for the most part behind the anterior lobe.

Considering these points in turn, the statement as to size of the median furrow is entirely correct; but as to whether it lies in the anterior or posterior half depends upon the previous selection of the anterior and posterior ends. The second and third statements postulate that the posterior end has already been selected. The fourth statement is one of primary importance.

---

[8] Ulrich, E. O., and Bassler, R. S., Proc. U. S. Nat. Mus., vol. 35, p. 280, 19

[9] Ulrich, E. O., and Bassler, R S., Maryland Geol. Surv., Silurian, p. 2 1923.

The location of the brood pouch would not, however, be as definite a criterion as the location of the ovary. While the brood pouch is usually located in close proximity to the ovary, there appear possibly to be a few exceptions. The position of greatest convexity on the valve, or of greatest thickness of the carapace when viewed dorsally should mark the position of the ovary. So, therefore, one must find a definite criterion for choosing the anterior end of the animal, then one may say that the swing is backward or forward, or that the median sulcus lies in the anterior half or the posterior half of the carapace.

Bonnema[10] lists five points which he considers of major importance in orientation: (1) the position of the two lateral eyes; (2) the position of the sex organs; (3) the location of the places on the interior of the valves where the adductor is attached; (4) the outline of the carapace; (5) the manner of closing the carapaces or the difference in size of the two valves.

(1) This consideration is to be borne in mind although it is of doubtful importance. It is by no means an ascertained fact that the tubercles or spines located in the anterior? dorsal region of *Paraparchites* and *Leperditia* represent the location of lateral eyes. It may or may not be that the node anteriorly bordering the sulcus of *Primitia tolli* indicates the position of the lateral eyes. Apparently corresponding nodes on other species surely could not have had the same function. In some cases nodes may be developed on both sides of the median sulcus. (2) This is an admittedly important point. The sex organs should lie in the thicker end of the carapace Bonnema brings out the valuable point that two kinds of individuals have never been found in a living ostracode, of which one differs from the other by the greater development of the anterior end. The converse, however, is quite true. (3) Bonnema states, from a consideration of the work of Müller,[11] that the places where the adductor is fastened to the interior of the valves are sometimes found on the middle part of the carapace, generally on the anterior half and seldom on the posterior half. He also indicates that the

---

[10] Bonnema, J. H., Jour. Pal., vol. 4, no. 2, p. 110, 1930.

[11] Müller, G. W., Die Ostracoden des Golfes von Neapel. Fauna und Flora des Golfes von Neapel und der angrenzenden Meeresabschnitte, 21 Monographie, 1894.

point of attachment is on the interior ridge corresponding to the chief median furrow on the exterior. (4) From a consideration of Cretaceous to Recent Ostracoda Bonnema states that the anterior end is often higher than the posterior, which is in agreement with the observations of the writer. Especially is this true when the outline of the carapace is of the oblong-subrhomboidal type, with rather straight dorsal and ventral margins. I do not agree with Bonnema that this is an inadequate arrangement, but think it is, on the contrary, entirely natural. The anterior end would require height but not thickness to accommodate the long anterior appendages, while the posterior end would require thickness, but not so much height. The resistance offered by the carapace during movement through the water is of small consideration in organisms of this type. With fast swimmers it is just as important that the posterior end be tapered as well as the anterior. It is true, nevertheless, that with Recent Ostracoda a sharp shoulder or blunt end indicates the posterior. (5) The last point regarding the manner in which the carapaces close, or the difference in the size of the two valves is of doubtful value. While the left valve may be the larger in the majority of cases, there are far too many exceptions to make this a useful consideration.

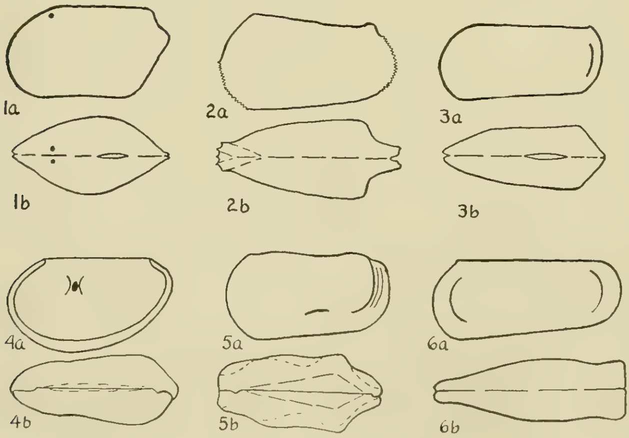


Figure 3.—Comparison of Modern types of Ostracoda (1, 2, 3) with Paleozoic types (4, 5, 6). According to the method of orientation advocated by the author, the anterior in each figure is directed to the left.

Diagram 1. **Loxoconcha australis** Brady, x40; **a**, left view, **b**, dorsal view.
Diagram 2. **Cythere dictyon** Brady, x40; a, left view, **b**, dorsal view.
Diagram 3. **Cythere falklandi** Brady, x40; **a**, left view, **b**, dorsal view.
Diagram 4. **Sansabella whittei**, n. sp., x27; **a**, left view, **b**, dorsal view.
Diagram 5. **Knightina texana** (Harlton), x27; **a**, left view, **b**, dorsal view.
Diagram 6. **Youngiella gracilia**, n. sp., x55; **a**, left view, **b**, dorsal view.

Blake[12] in discussing sexual dimorphism of the genus *Hollinella* denied that the frill could be used as a brood chamber. While the arrangement might not have been ideal, the idea should not be entirely abandoned. The anterior appendages would function for the most part ahead of the frill. Blake, a student of living Ostracoda, suggested that the frills may have served as outriggers to prevent the animals from sinking too deeply in the soft mud on the surface of which many forms live. He further states that "if any sexual dimorphism is to be found it will be in the posterodorsal region primarily." The most perplexing thing to the writer about the frills is not that they may or may not have been used for brood chambers, but that some of the adult females (?) have frills which curve around ventrally forming a chamber, but others of the same (?) species have frills which flare outward.

Kummerow[13] used the same factors employed by Bonnema and arrived at totally different conclusions, confirming the orientation of Ulrich and Bassler in regard to the Beyrichiacea. He would eliminate factors 1, 2, 3, and 5, considering that factor 4, the location of the brood pouch, was the most readily determinable. The writer believes that this is placing too much stress on the position of the brood pouch and not enough on the position of the ovary. *Treposella* (*Beyrichia*) *lyoni* Ulrich has the brood pouch at the middle of the ventral edge, and in some species the brood space may extend around part or all of the margin of the carapace. In the correlation of the elaborate nodes and lobes of these complex forms might not one be led to relationships which are more apparent than real?

---

[12] Blake, Charles H., Jour. Pal., vol. 4, no. 3, p. 297, 1930.
[13] Kummerow, Egmont, Jour. Pal., vol. 5, no. 2, p. 155, 1931.

Blake[14] gives valuable descriptions with figures of the ovaries of *Cypricercus,* and the shell structure of *Cythere lutea.* Bonnema had asked, since the testes of *Strandesia strandesmoides* extend over the entire length of the interlamellar space in the valves, might not this also be true of the ovaries? Blake's description of *Cypricercus,* which he considers to be the same as *Strandesia,* definitely shows that the ovary is confined to the posterior portion of the carapace.

Geis[15] has anticipated the writer in regard to the orientation of the Carboniferous Ostracoda, and has independently arrived at what I believe to be the correct orientation of these forms. He finds that modern ostracodes that are strongly inflated at one end, and comparatively thin at the other, show that the inflated end is posterior. He places considerable stress on the shaping of the animal in this manner in order to facilitate movement. As I have already stated, I do not believe that these animals moved fast enough to make this really important. The presence of any forward pointing spines would have been much more of a handicap. These were no doubt very largely bottom living forms and such spines would have continually encountered vegetation and debris. The second point which Geis makes is that recent forms which possess the oblong-rhomboidal outline have the obtuse dorsal angulation at the anterior, and the ventral truncation at the posterior end. This is entirely true and has been observed by other writers. A very important fact , which Geis has also observed, is that the end containing the retral swing is more or less stable, while the other end, the inflated end, shows great variability as to the amount of inflation from one individual to another. Geis correctly accounts for this by assigning the stable featurse of the animal's anatomy, the head, antennae, and mandibles to the non-variable portion of the carapace, and the posterior, unstable part of the animal to the variable portion of the carapace. This would not only allow for variation among the females, but would allow for sexual dimorphism where the only apparent difference between the sexes is the posterior inflation of the females. Geis therefore orients, correctly I believe, the genera *Jonesina, Sansabella, Glyptopleura, Kirkbya,* and *Amphissites* with the right valve the larger, and the strongest convexity posterior.

---

[14] Blake, Charles H., Jour. Pal., vol. 5, no. 2, p. 160, 1931.

[15] Geis, H. L. Some Ostracodes from the Salem Limestone, Mississippian, of Indiana, Jour. Pal., vol. 6, no. 2, pp. 150-155, 1932.

Bonnema[16] in replying to Kummerow's paper[17] brought out some interesting points in regard to brood pouches. *Nesidea?* (Bairdia) from the Cretaceous from South Limburg seems to have a brood(?) space on the anterior and posterior part of each valve. He also mentions the fact that in the living ostracode *Chlamydotheca speciosa* Dana a brood(?) space is found at both ends of the carapace, and in *Chlamydotheca incisa* Claus a brood space is found only at the anterior end. Figures of these last two species after Sars are given. At the end of his discussion Bonnema quotes some interesting passages from Prof. G. W. Müller's Handbuch der Zoologie gegründet von Kückenthal, herausgegeben von Krumbach Bd. III, 1927. These paragraphs deal with the motion and the organs of motion of Ostracoda, and tend to show that ostracodes are not always free swimmers but may burrow about in the mud of the bottom. The natatory setae of the males are better developed for swimming, while the appendages of the females are better adapted for crawling and digging. After copulation the females of some species are known to lose their natatory setae, perhaps biting them off, and losing their ability to swim.

From a consideration of the literature dealing with orientation it can readily be seen that many criteria have been employed. One salient feature, however, which has few exceptions presents itself. Sexual dimorphism, if any, shows primarily in the posterior inflation of the valves, disbarring any abnormal brood pouches such as submarginal swellings or frill chambers. The thicker and more variable end is therefore to be regarded as the posterior. From this we can work forward to other considerations. In certain recent forms like *Cythere* the anterior end is thinner when viewed dorsally, but is often much higher than the posterior when viewed laterally. In many cases there is a decided forward swing. The genus *Cythere* occurs as far back as the Mesozoic, and must surely have been derived from some late Paleozoic form which belonged to the *Kirkbyidae, Glyptopleuridae,* or the *Youngiellidae,* all of which have been orientated exactly the opposite to *Cythere.* The size of the valves and manner of overlap, the position of the sulci and lobes, etc., therefore depend upon the first consideration and are subservient to it.

---

[16] Bonnema, J. H., Jour. Pal., vol. 6, no. 3, p. 288, 1932.
[17] Kummerow, Egmont, op. cit., 1931.

The orientation of each family of ostracodes described in this paper will be discussed in the systematic descriptions.

SYSTEMATIC DESCRIPTIONS

Family APARCHITIDAE Ulrich and Bassler, 1923

This family was proposed by Ulrich and Bassler for "simple, unsulcated, smooth ostracoda usually larger than the average size with straight hinge line and thickened, often channeled, free edges, the edge of one valve sometimes slightly overlapping the other ventrally." The hinge line may be depressed below the dorsal regions of the valves.

Genus PARAPARCHITES Ulrich and Bassler, 1906

Genoholotype, *Paraparchites humerosus* Ulrich and Bassler, 1906, Proc. U. S. Nat. Mus., vol. 30, pp. 150, 151, pl. 11, figs. 1-4. (Elmdale formation, Kansas.)

Carapace leperditoid or subovate in lateral view; valves unequal, ventral edge of right valve rabbeted so as to overlap the beveled edge of the left valve; left valve may overlap right slightly at the hinge line; surface smooth, sometimes with a small tubercle or spine in the antero-cardinal third of one or both valves.

The original descriptions of the genus and genotype may be consulted by referring to the original publication, or to Kellett, 1933, Jour. Pal., vol. 7, pp. 63, 64, and 65, where they have been quoted.

Because of insufficient evidence as to the orientation of these forms, the conventional method of using the end with the spine and the less obtuse cardinal angle as anterior has been followed. This gives the conventional "backward" swing to the carapace.

There seems a lack of evidence that the spines represent the tions of the lateral eyes, since many forms have only one For the present, however, the orientation is not though the inflation often observed in the more acute inal angle could better be explained if that were the postero-dorsal region rather than the antero-dorsal.

Several totally different and unrelated forms may have been included in this genus, their resemblances being merely superficial.

Paraparchites Wapanuckensis Harlton Plate 1, fig. 1

Paraparchites wapanuckensis Harlton, 1928, Jour. Pal., vol. 2, p. 132, pl. 21, fig. 1. (Wapanucka limestone, Pittsburg County, Oklahoma.) —Harlton, 1929, Am. Jour. Sci., 5th. ser., vol. 18, p. 255, pl. 1, fig. 3. —Harlton, 1933, Jour. Pal., vol. 7, p. 19, pl. 6 figs. 1a, 1b. (Johns Valley shale, southeastern Oklahoma.)

Carapace semicircular or subovate in lateral view, with backward swing; greatest length near median line; greatest height just posterior to the center; dorsal margin straight; hinge line straight, long; a pronounced spine points upward from the swollen antero-cardinal portion of each valve; surface smooth. Length, .57 mm.; height, .4 mm.

This form has been identified with *P. wapanuckensis,* although it does not agree well with the first two of Harlton's figures. It is more like his latest figure. The prominence of the spine, and the fact that it points more upward than outward suggests Harlton's species, although he probably included in it those I have placed in *P. ottervillicus* n. sp. Both are closely related to *P. dornickhillicus,* with *P. ottervillicus* intermediate between the other two.

Plesiotype.—Indiana University Paleontological Collections No. 2149.

Dornick Hills formation, locality 155, three and three-fourths miles north and two miles west of Ardmore, Oklahoma.

Paraparchites Ottervillicus, n. sp. Plate 1, fig. 2

Carapace unsymmetrically semicircular in lateral view, with backward swing; dorsal margin and hinge line long and straight; greatest height posterior to center; axis of elongation oblique to hinge line; anterior broadly rounded, greatest forward extension about half way between dorsal spine and median line; posterior broadly rounded; ventral margin strongly convex, rounded evenly into posterior and anterior margins; surface smooth. Length, .67 mm.; height, .46 mm.

Distinguished from *P. wapanuckensis* Harlton by the fact that the axis of elongation is more oblique to the hinge line, the antero-cardinal angle is slightly more obtuse, the spine less prominent, pointing more outward than upward, and the antero-dorsal bulge more prominent, as in *P. dornickhillicus,* although in no case is the straight dorsal margin affected.

Holotype.—Indiana University Paleontological Collection No. 2150.

Dornick Hills formation, locality 155, about three and three-quarters miles north and two miles west of Ardmore, Oklahoma. Also locality 146, and locality 162.

Paraparchites dornickhillicus, n. sp. Plate 1, fig. 5

Carapace subovate in lateral view, with backward swing; hinge line straight, depressed; dorsal margin curved upward due to the high dorsal and dorsal-anterior inflation; greatest height central; greatest length median, only slightly oblique to hinge line; anterior margin gently convex, posterior broadly rounded; ventral margin strongly convex, smoothly rounded into posterior and anterior margins; surface smooth. Length, .78 mm.; height, .59 mm.

Distinguished from *P. wapanuckensis* and *P. ottervillicus* by the extremely high postero-dorsal inflation and lack of a spine.

Holotype.—Indiana University Paleontological Collections No. 2037.

Dornick Hills formation, midway between Lester limestone and Otterville limestone, locality 152, about four miles northwest of Ardmore, Oklahoma. Also localities 162, 163, and 165.

Paraparchites guthreyi, n. sp. Plate 1, fig. 4

Carapace subovate in lateral view; hinge line straight and short, about half the length of the shell; greatest height slightly posterior to center; greatest length nearly median, almost parallel to hinge line; posterior end much more broadly rounded than anterior; ventral margin less convex than end margins but merging smoothly into them; both cardinal angles very obtuse; surface smooth, evenly convex. Length, .74 mm.; height, .5 mm.

This form is very similar to *P. oviformis* Coryell and Rogatz, from the Arroyo formation, Permian of Texas, but is more convex ventrally. It is different enough to be considered distinct, since the difference in horizons is so great, one being lower Pennsylvanian, and the other Permian. It resembles less closely *P. lacuensis* Knight, from the upper Fort Scott limestone, St. Louis County, Missouri, and the form identified by Harlton as *P. inornata* (McCoy) from the Cisco of Texas.

Holotype.—Indiana University Paleontological Collections No. 2061.

Dornick Hills formation, locality 155, three and three-quarters miles north and two miles west of Ardmore, Oklahoma.

Paraparchites elongatus, n. sp. Plate 1, fig. 3

Carapace small, elongate, subovate in lateral view, with backward swing; hinge line straight, short; cardinal angles extremely obtuse, indistinct; greatest height posterior, almost at the posterior end of hinge line; greatest length obliquely through center of shell converging on anterior extension of hinge line at an angle of about thirty degrees; posterior end much broader than anterior, both symmetrically rounded; ventral margin sloping up in a gently convex line from the broad semicircular posterior end to the more narrow semicircular anterior end; surface smooth, greatest convexity anterior (?). Length, .63 mm.; height, .4 mm.

Holotype.—Indiana University Paleontological Collections No. 2053.

Dornick Hills formation, Otterville limestone, locality 146, seven miles south of Ardmore, Oklahoma.

This resembles no species that I have seen referred to *Paraparchites.* It may not belong to this genus.

Paraparchites brazoensis Coryell and Sample Plate 1, fig. 8

Paraparchites brazoensis Coryell and Sample, 1932, Am. Mid. Nat., vol. 13, p. 249, pl. 24, fig. 5. (East Mountain shale, Mineral Wells, Texas.)

Carapace subovate, length about 1.47 times height; hinge line straight; greatest height central or slightly posterior to center; greatest length median, nearly parallel with hinge line; anterior and posterior margins broadly rounded; posterior end widest with more obtuse cardinal angle, giving a backward swing to carapace; ventral margin evenly convex; antero-dorsal spines long, rather broad at base, and antero-dorsal region inflated. Length, .69 mm.; height, .47 mm.

Plesiotype.—Indiana University Paleontological Collections No. 2062.

Deese formation, locality 80, eight miles northwest of Ardmore, Oklahoma.

Paraparchites, n. sp. Plate 1, fig. 6

Carapace semicircular in lateral view, with slight backward swing; hinge line long, straight, dorsal margin straight except at antero-cardinal area where it bends upward to meet the broadly rounded anterior margin with a prow-like effect; posterior and ventral margins merged in one smooth semicircular curve; greatest height slightly posterior to center; greatest length slightly above center, axis parallel to hinge line; surface apparently evenly convex. Length, .67 mm.; height, .46 mm.

Hoxbar formation, Union Dairy limestone, locality 22, two and one-half miles south of Ardmore, Oklahoma.

This species was not named because the material is too poorly preserved to provide a type specimen. The outline, however, I believe to be exact, so that the figure and description may be of some value to other workers.

Specimen.—Indiana University Paleontological Collections No. 2027.

Paraparchites harltoni, n. sp. Plate 1, figs. 9a, b

Carapace subovate in lateral view; length 1.43 times height, and 1.6 times length of hinge line; hinge line straight, very slightly depressed; greatest thickness central; greatest height slightly posterior to middle; axis of greatest length about median, slightly oblique, projecting anteriorly upward toward the hinge line at a low angle; anterior, posterior, and ventral margins about equally convex, except at the extremities with point of greatest height on the ventral margin where the convexity increases; valves unequal, right overlapping the left noticeably on the ventral margin; left valve bearing a spine-like tubercle on the antero-dorsal region one-quarter of the hinge line length from the antero-cardinal angle; surface smooth, evenly convex. Length, .92

mm.; height, .64 mm.; thickness, .46 mm.

Holotype.—Indiana University Paleontological Collections No. 1981.

Deese formation, Arnold limestone, locality 67, about nine miles northwest of Ardmore, Oklahoma.

This species somewhat resembles *P. nicklesi* (Ulrich) and *P. claytonensis* Knight. The latter attains a much greater size. The peculiarity of having a tubercle on the left valve only, at least in some specimens, is common to all three. *P. nicklesi* may have been the ancestor of the other two species.

Paraparchites ? ardmorensis, n. sp. Plate 1, figs. 7a, b

Carapace elongate, leperditoid; hinge line straight, slightly depressed; dorsal margin straight; greatest height just posterior to center; greatest length above center; axis converging anteriorly at a low angle on projection of hinge line; both cardinal angles obtuse, anterior less obtuse than posterior; anterior margin not smoothly rounded, two obtuse angles apparent, one of about 120 degrees just below cardinal angle at greatest anterior extension, and a second more obtuse, rounded angle where the anterior margin merges into the ventral margin; ventral margin divided into two parts, one longer portion which slopes downward and backward in nearly a straight line from the obtuse angle above mentioned to a point almost directly below the center of the shell where it is jointed at a very obtuse angle of about 145 degrees to a shorter portion of the ventral margin which is almost horizontal; this last portion converges upward shortly into the rather broadly rounded posterior margin which appears slightly truncated postero-ventrally. Length, .61 mm.; height, .34 mm.; thickness, .27 mm.

Holotype.—Indiana University Paleontological Collections No. 2030.

Hoxbar formation, Union Dairy limestone, locality 13, railroad cut northwest of cemetery at south edge of Ardmore, Oklahoma. Also locality 47, Confederate limestone.

Paraparchites ? sp. undet. Plate 1, fig. 10

Carapace large, oval-shaped in lateral view; dorsal margin almost as convex as ventral margin; orientation doubtful; left (?) valve slightly smaller than right, accentuated somewhat by crushing which has probably caused the valves to slip slightly in relation to each other; no hinge line observed; surface appears to be ornamented by large shallow reticulations with net-like ridges between, on which are faint beads arranged in a more or less regular pattern, usually at the intersection of the net-like ridges. Length, 1.6 mm.; height, 1.6 mm.

Specimen.—Indiana University Paleontological Collections No. 2085.

Hoxbar formation, locality 60, shale about 75 feet above the Westheimer member, six miles south and two and one-quarter miles east of Ardmore, Oklahoma.

Several fragmentary specimens of this peculiar form have been found. They are usually preserved in limonite, and may not even be Ostracoda.

Family PRIMITIIDAE Ulrich and Bassler, 1923

Carapace oblong, subquadrate, or subrhomboidal in lateral view; hinge line long and straight, often depressed, interior smooth, grooved longitudinally, or having processes or apophyses at the cardinal angles which fit into corresponding excavations in the other valve; sulcus or pit poorly to well defined; low nodes and ridges, or horns or spines of considerable size may be developed; valves equal, or nearly equal; surface smooth, papillose, punctate, or reticulate.

In the present paper there are two genera which may belong to this family: *Coryellina*, n. gen., and *Mammoides*, n. gen.

Alexander[18] has shown that *Monoceratina* Roth belongs in the family *Cytheridae*, and not with the *Primitiidae*[19].

Genus CORYELLINA, n. gen.

Genotype, *Coryellina capax*, n. sp.

This new genus is placed in the family *Primitiidae* because of the sulcus, the long, straight hinge line, and the approximately equal valves. The lack of overlap and the character of the hinge seem to exclude it from the *Kloedenellidae*. The obese, square end is chosen as the posterior end.

---

[18] Alexander, C. I., Jour. Pal., vol. 7, no. 2, p. 202, 1933.

[19] The plates for this paper were prepared previously to the publication by Dr. Alexander, and consequently the figures for **Monoceratina** are on plate 1 with the Primitiidae.

Carapace tumid, subrhomboidal in lateral view, subtriangular to subcylindrical in end view; hinge line long, straight; in the cardinal angles the right valve has processes which fit into corresponding excavations in the left; posterior half very obese with ventral commisure line depressed; posterior inflation of valves may be drawn out into sharp node-like protuberances; sulcus near middle of dorsal half; valves nearly equal; surface smooth or punctate.

This genus is unlike any other ostracode genus known to the writer. It is perhaps most closely related to *Jonesina.*

The name of this genus is given in honor of Dr. H. N. Coryell, Columbia University, New York City.

Coryellina capax, n. sp. Plate 1, figs. 11a, b, c, d

Carapace thick, extremely tumid, subrhomboidal in lateral view; bicuneate in dorsal view, thin on dorsal and anterior edges; hinge line straight, nearly as long as total length; at the ends of the hinge line, in the sharp cardinal angles, the right valve has processes which fit into corresponding excavations in the cardinal angles of the left valve; the swing is forward; anterior margin gently convex, rounding sharply into the gently convex ventral margin; posterior margin drawn out into sharp node-like projections when viewed from the side, but appearing blunt and sharply truncated when viewed from above; the line of commisure is completely depressed, anteriorly, ventrally, and less so posteriorly, the obesely convex valves overhanging all around, with consequent furrow marking the contact; dorsally the hinge line is depressed only in the posterior half; appearance subtriangular to subcylindrical in end view; sulcus near middle, extending down from dorsal margin, nearly to median line, and pointing slightly backwards; valves nearly equal, right valve may be slightly larger than left; surface smooth or punctate. Length, .8 mm.; height, .52 mm.; thickness, .54 mm.

Holotype.—Indiana University Paleontological Collections No. 2051.

Deese formation, locality 68, seven miles south and one and one-half miles east of Ardmore, Oklahoma.

Genus MAMMOIDES, n. gen.

Genotype, *Mammoides mammillata,* n. sp.

Carapace small, oblong-subquadrate in lateral view; hinge line long, straight, smooth on inside, having a very obscure rib-like groove on some specimens; no denticulation observed; cardinal angles obtuse but distinct; ends smoothly and nearly equally rounded; ventral margin convex; valves appear to be approximately equal; surface evenly convex, varying from smooth to granulose or even finely papillate, modified by two broad-based mammilliform nodes arising from the dorsal half of the carapace and separated by a depressed area or shallow sulcus; a third very low, round tubercle may be present on the anterior edge of the valve.

This genus differs from *Aechminella* Harlton in lateral outline, lack of marginal ridges, absence of reticulations, and character of the spines.

Mammoides mammillata, n. sp. **Plate 1, fig. 21**

Carapace small, oblong-subquadrate in lateral view; greatest height near middle; greatest length median; greatest thickness posterior to middle; hinge line long, straight, not depressed, smooth on inside, having a long obscure rib-like groove on some specimens; no denticulation observed; cardinal angles obtuse but distinct; dorsal margin straight; ends smoothly and nearly equally rounded; ventral margin convex, merging imperceptibly into end margins; valves approximately equal; surface evenly convex, finely granulose to papillose, modified by two broad-based mammilliform nodes, arising from the dorsal half of the carapace and separated by a depressed area or shallow sulcus; a third very low, round tubercle is present at the anterior end near the median line. Length, .76 mm.; height, .45 mm.

Holotype.—Indiana University Paleontological Collections No. 2004.

Deese? formation, locality 80, .7 mile northwest of Deese School, and about eight miles northwest of Ardmore, Oklahoma.

This species is represented by five single valves in the author's collections. The ends appear identical so that the half containing the point of greatest thickness has been chosen as posterior.

Family KLOEDENELLIDAE Ulrich and Bassler, 1923

More or less inequivalved Ostracoda which are semi-ovate, subovate, or subrhomboidal in lateral view. The hinge line is straight and short to long; the dorsum distinctly furrowed or flush, and there may be denticulation at the cardinal angles. The right valve is usually the larger and overlaps the left. One main sulcus or pit is present but there may be other minor sulci. The surface is smooth or finely reticulate.

In this paper there are four genera which belong in this family: *Jonesina, Sansabella, Kirkbyina,* and the new genus *Nuferella*. The customary orientation has been reversed so that the thicker and most variable end is posterior. This makes the larger valve the right valve, except in the genus *Kirkbyina*. The swing is usually forward and the sulcus usually located in the anterior half. It is interesting to note that when species similar to the one described by Warthin[20] as *Jonesina texana* Harlton were placed in the new genus *Sulcella* by Coryell and Sample[21], the dorsal overlap brought to their attention the resemblance to cytherelloid forms, and the thicker end was chosen as posterior.

Genus JONESINA Ulrich and Bassler, 1908

Beyrichia (part) Jones and Kirkby, 1886, Ann. and Mag. Nat. Hist, (5), XVIII, p. 258; 1886, Geol. Mag., vol. 3, p. 438.

Beyrichiella (part) Ulrich and Bassler, 1906, Proc. U. S. Nat. Mus., vol. 30, pp. 151-55.

Jonesina Ulrich and Bassler, 1908, Proc. U. S. Nat. Mus., vol. 35, p. 324, pl. 44, figs. 6-16; 1923, Md. Geol. Surv., Silurian, p. 314, fig. 21, no. 5. —Knight, 1928, Jour. Pal., vol. 2, p. 241. —Kellett 1933, Jour. Pal., vol. 7, p. 76.

Genotype, *Jonesina fastigiata* (Jones and Kirkby), designated by Ulrich and Bassler, 1908, op. cit., when the genus was erected.

Jonesina arcuata (Bean) Plate 2, figs. 6, 7

Cypris arcuata Bean, 1836, Ann. Mag. Nat. Hist., vol. 9, woodcut fig. 55.

Beyrichia arcuata (Bean) Jones and Kirby, 1886, Geol. Mag., vol. 3, p. 438, pl. 12, figs. 12-14. (Carboniferous rocks of Great Britain.)

Jonesina arcuata (Bean) Ulrich and Bassler, 1908, Proc. U. S. Nat. Mus., vol. 35, p. 324, pl. 44, figs. 17-19. (Copied from Jones and Kirkby.) —Harlton, 1927, Jour. Pal., vol. 1, p. 205, pl. 32, figs. 6a-c. (Lower Glenn, Dornick Hills, Ardmore Basin, Love County, Oklahoma.) —Knight, 1928, Jour. Pal., vol. 2, p. 243, pl. 31, figs. 6a, b, pl. 33, fig. 6. (Fort Scott limestone, St. Louis County, Missouri.)

Carapace subovate in lateral view; cuneate in dorsal view;

---

[20] Warthin, Okla. Geol. Surv., Bull. 53, p. 60, pl. 4, fig. 10, 1930.

[21] Coryell and Sample, Am. Mid. Nat., vol. 13, No. 5, p. 274, 1932.

posterior end thickest, variably inflated; greatest height slightly anterior to center; greatest length near by median, but slightly oblique, converging posteriorly toward the hinge line; median sulcus deep, distinct, extending down from the hinge line and ending in a circular pit anterio-dorsad of center; anterior sulcus indistinct, located at anterior end of hinge line, separated from median sulcus by a distinct node; surface finely reticulate, more distinctly on some specimens than on others.

Plesiotypes.—Indiana University Paleontological Collections No. 1988a, (side view). Length, .8 mm.; height, .5 mm. No. 1988b, (dorsal view). Length, .67 mm.; thickness, .34 mm.

Dornick Hills formation, locality 160, Jolliff limestone (1988a), ten miles north and four and three-quarters miles east of Ardmore, Oklahoma; locality 152 (1988b), three and one-half miles north and two miles west of Ardmore. Also abundant at localities 148, 162. It may be found in almost any fossiliferous sample from the middle and lower Dornick Hills in this area.

Jonesina gallowayi, n. sp. Plate 2, figs. 8a, b

Carapace subrhomboidal in lateral view; slight forward swing; greatest height and thickness in posterior half; greatest length median; hinge line straight, rather long, depressed; dorsal furrow broad, distinct; dorsal margin straight; posterior end broadly rounded; anterior margin composed of two rather distinct parts, both only slightly convex, joined just above the median line with a rounded angle of about 140 degrees; ventral margin very slightly concave; sulcus very deep, extending downward from anterior dorsal region, ending in a deep circular pit, deeper portion of the sulcus dumbell shaped; surface smooth; overlap very strong posteriorly and ventrally. Length, .82 mm.; height, .53 mm.; thickness, .46 mm.

Holotype.—Indiana University Paleontological Collections No. 2159.

Deese formation, locality 126, three and one-half miles south of Ardmore, Oklahoma. Also a poorly preserved specimen at locality 98, Deese formation, about eight miles northwest of Ardmore, Oklahoma.

This species is named in honor of Dr. J. J. Galloway, Indiana University, Bloomington, Indiana.

Jonesina biformis, n. sp. Plate 2, figs. 9a, b; 11a, b

Carapace semi-ovate in lateral view; with a slight forward swing; greatest height near middle; greatest length slightly above center, and oblique to hinge line, converging posteriorly; greatest thickness posterior in inflated (female?) individuals, central in non-inflated (male?) individuals; anterior smoothly rounded, extremity low; posterior end evenly rounded, extremity high; sulcus very faint, extending downward and forward from about one-third the length from the front end of the hinge line and roughly paralleling the upper anterior margin; ventral margin gently convex; hinge line short, straight; dorsal margin convex, overlapping? or protruding; edge of right valve distinctly seen from the left side; overlap even all around, distinct; surface smooth.

Female?; length, .62 mm.; height, .4 mm.; thickness, .29 mm.

Holotype.—Indiana University Paleontological Collections No. 1986.

Male?; length, .59 mm.; height, .36 mm.; thickness, .22 mm.

Paratype.—Indiana University Paleontological Collections No. 1990.

Deese? formation, locality 78, about eight miles northwest of Ardmore, Oklahoma, and .6 miles north of Deese School.

These two forms are about equally abundant in the same sample. They are distinct in appearance and easily separated. Nevertheless their very great similarity and association together suggest that the striking difference in obesity is a sexual rather than a specific character.

Jonesina hoxbarana, n. sp. Plate 2, figs. 10a, b

Carapace subelliptical or subovate in lateral view; greatest height and thickness one-fifth of the length from the posterior end; hinge line short, straight, depressed, concealed in side view by inflation of the carapace; distinct dorsal furrow; anterior cardinal angle very obtuse; ends rounded, anterior more convex than posterior; ventral margin concave; overlap greatest at cardinal angles and ventral margin, practically nil on anterior margin; sulcus distinct, wide and shallow at dorsal margin, constricting downward to a pit and then becoming broader and more shallow and disappearing in the convexity of the valve surface; surface smooth. Length, .76 mm.; height, .45 mm., thickness, .37 mm.

Holotype.—Indiana University Paleontological Collections No. 1983.

Hoxbar formation, locality 53, shale 200 feet above the Westheimer member, six miles south and two and one-half miles east of Ardmore, Oklahoma.

This species resembles considerably *J. ampla* Warthin. It differs, however, in the concave ventral margin, which in some cases is more concave than in the specimen figured. It also differs in the lack of overlap on the anterior margin, and in the lower anterior end. A resemblance was also noted to photographs of *J. distenta* Kellett.

Jonesina daubeana, n. sp. Plate 2, figs. 13a, b

Carapace subrhomboidal in lateral view, with pronounced forward swing; greatest height at anterior cardinal angle; greatest length near by median, axis oblique, converging posteriorly toward hinge line; greatest thickness slightly posterior to center; hinge line straight, posterior portion obscured in side view by left valve, dorsum not distinctly furrowed; ends evenly rounded, anterior more convexly rounded; ventral border slightly concave; sulcus distinct, sharply incised but not deep; two slight secondary sulci on the figured specimen, one at the anterior cardinal angle, and a second about half way between the main sulcus and the posterior end; overlap distinct and very even; surface smooth. In dorsal view the ends appear blunt and square. A thin keel may be seen on each valve near and parallel to the contact line. Length, .73 mm.; height, .42 mm.; thickness, .31 mm.

Holotype.—Indiana University Paleontological Collections No. 1996.

Hoxbar formation, locality 8, near Daube limestone, two and one-half miles south and three-quarters mile east of Ardmore, Oklahoma.

This species may be distinguished from *J. deesensis*, n. sp., by the concave ventral border, the position of greatest thickness, the blunt, square ends in dorsal view, and the sharp keels paralleling the commisure line[22] at each end.

Jonesina gregaria (Ulrich and Bassler) Plate 2, figs. 12a, b

Beyrichiella gregaria Ulrich and Bassler 1906, Proc. U. S. Nat. Mus., vol. 30, p. 157, pl. 11, fig. 18. (Coal Measures, Kansas City, Missouri.)
Jonesina gregaria Ulrich and Bassler, 1908, Proc. U. S. Nat. Mus., vol. 35, p. 325, pl. 44, fig. 6. —Knight, 1928, Jour. Pal., vol. 2, p. 241, pl. 31, figs. 5a-f. (Upper Fort Scott limestone, St. Louis County, Missouri.) —Warthin, 1930, Okla. Geol. Surv., Bull. 53, p. 60, pl. 4, fig. 11. (Wewoka, east-central Oklahoma.)

Carapace subelliptical to subrhomboidal in lateral view, with a slight forward swing; greatest length median; greatest height near the middle; hinge linge long, straight, posterior part usually slightly depressed, depending on the amount of posterior inflation; ends smoothly rounded; ventral margin usually convex, when concave the carapace has probably been distorted; sulcus deep, anterior to middle, extending well below median line; posterior half variably, sometimes greatly inflated, greatest thickness about one-fourth way from posterior end; small spine near hinge line above point of greatest inflation; overlap even and distinct on anterior, posterior, and ventral margins; surface smooth on smaller specimens, distinctly and evenly pitted on some of the larger specimens. Length, .75 mm.; height, .47 mm.; thickness, .37 mm.

Plesiotype.—Indiana University Paleontological Collections No. 1984.

Deese (?) formation, locality 78, .6 mile north of Deese School, and about eight miles northwest of Ardmore, Oklahoma. Also locality 69, a specimen doubtfully referred to this species.

Jonesina deesensis, n. sp. Plate 2, figs. 14a, b

Carapace subrhomboidal in lateral view, with a pronounced forward swing; hinge line short, depressed in the posterior half, dorsum furrowed; anterior cardinal angle much more obtuse than posterior; anterior margin more convex than posterior margin; ventral margin straight to slightly convex; greatest length obliquely through center, axis converging posteriorly on hinge line; greatest height anterior; greatest thickness near center of posterior half; sulcus poorly defined, slightly anterior to middle; overlap slight, indistinct, but even; surface smooth. Length, .79

---

[22] The commisure line is the line of junction or contact of the two valves as seen from the outside.

mm.; height, .45 mm.; thickness, .35 mm.

Holotype.—Indiana University Paleontological Collections No. 1987.

Deese formation, locality 79, .7 mile north of Deese School, and about eight miles northwest of Ardmore, Oklahoma.

This species somewhat resembles *J. acuneata* Warthin. It differs mainly in posterior inflation, which is near the center in *J. acuneata,* and in the sulcus which is quite indistinct and can only be seen near the dorsal margin, whereas in *J. acuneata* the sulcus is more apparent just above the median line.

Jonesina dubia, n. sp. Plate 3, figs. 1a, b

A rather odd looking specimen is associated with *J. gregaria* and *J. biformis,* n. sp. It is well preserved and not in the least distorted, so I shall describe it briefly.

In lateral view the small carapace would be semi-elliptical cut if the posterior end were not sharply truncate; hinge line long for the genus, straight, completely depressed and dorsum furrowed from one end to the other; anterior cardinal angle obtuse, posterior angle sharp, nearly ninety degrees; greatest height central; greatest length median; greatest thickness in posterior half; anterior end smoothly rounded; posterior end sharply truncate, greatest posterior extension low, at the junction with the convex ventral margin; sulcus distinct, V-shaped, slightly anterior to center; faint secondary sulcus in antero-cardinal region; ovelap rather wide; two keels paralleling the commisure line on the anterior end, the one on the left valve being farthest from the contact; surface smooth. Length, .52 mm.; height, .36 mm.; thickness, .24 mm.

Holotype.—Indiana University Paleontological Collections No. 1985.

Deese ? formation, locality 78, .6 mile north of Deese School and eight miles northwest of Ardmore, Oklahoma.

Jonesina trisulcata, n. sp. Plate 2, figs. 15; 16a, b; 17a, b

Carapace subquadrate in lateral view; greatest height near middle; greatest length near median line, axis oblique, converging posteriorly on hinge line; greatest thickness about one-fifth the length from the posterior end; dorsal margin slightly convex; anterior and posterior margins rounded, the anterior more convexly so; ventral margin slightly concave; three sulci apparent, one on each side of the main sulcus which is V-shaped and extends nearly to the median line; a broad scroll-like ridge parallels the anterior margin; overlap broad ventrally, practically nil on anterior margin and middle of dorsal margin; surface smooth. Length, .75 mm.; height, .41 mm.; thickness, .36 mm.

Holotype.—Indiana University Paleontological Collections No. 1889.

Deese formation, locality 98, one mile north and one-half mile east of Deese School, eight miles northwest of Ardmore, Oklahoma.

A specimen occurring in the same sample has been figured and doubtfully referred to this species. It may represent a male individual. The concave ventral margin is slightly distorted, but otherwise the specimen is intact. The two secondary sulci are wanting, but the anterior marginal ridge is present. The posterior portion of the dorsum is less distinctly channeled, but this may be attributed to the slenderness of the form. Length, .73 mm.; height, .38 mm.; thickness, .26 mm.

Specimen.—Indiana University Paleontological Collections No. 1891.

Genus SANSABELLA Roundy, 1926

Sansabella Roundy, 1926, U. S. Geol. Survey, Prof. Paper 146, p. 5.

Genotype, *Sansabella amplectans* Roundy, 1926, op. cit., p. 6, pl. 1, figs. 3a-5. (Marble Falls limestone, San Saba County, Texas.)

Sansabella whitei, n. sp. Plate 3, figs. 2a, b

This species is practically identical in appearance with *Kirkbyina laevis* Warthin, except that the valves are reversed. Here the right valve is the larger as in the genus *Jonesina*. Indeed, if the genus *Sansabella* had not already been erected, I should have placed this species in the genus *Jonesina*. The difference seems to be mainly in the more pronounced denticulation and in the sulcus, which in this case is more of a pit than a true sulcus. The occurrence together in about equal abundance of these two species, one of which is a mirror image of the other, raises the interesting question of whether ostracodes of the same species may be both dextral and sinistral. So far as the writer is aware no such case is on record. Length, .74 mm.; height, .43 mm.; thickness, .34 mm.

Holotype.—Indiana University Paleontological Collections No. 2071.

Hoxbar formation, locality 55, about 75 feet above the Westheimer member, six miles south, and two and one-fourth miles east of Ardmore, Oklahoma. Also locality 60, near the same horizon as locality 55, and locality 78, about eight miles northwest of Ardmore.

This species is named for Dr. Maynard P. White, of Ardmore, Oklahoma.

Genus KIRKBYINA Ulrich and Bassler, 1908

Kirkbyina Ulrich and Bassler, 1908, Proc. U. S. Nat. Mus., vol. 35, p. 322.

Kirkbyina laevis Warthin Plate 3, figs. 3a, b

Kirkbyina laevis Warthin, 1930, Okla. Geol. Surv., Bull. 53, p. 62, pl. 14, figs. 12a, b. (Wewoka formation, east-central Oklahoma.) —Coryell and Sample, 1932, Am. Mid. Nat., vol. 13, p. 256, pl. 24, fig. 11. (East Mountain shale, Mineral Wells, Texas.)

Carapace subrhomboidal in lateral view; hinge line straight, depressed, denticulation distinct; dorsal margin straight; anterior cardinal angle more obtuse than posterior giving forward swing to the carapace; anterior rounded, extremity low; posterior rounded, extremity high; ventral margin evenly convex; left valve overlapping right strongly on anterior, posterior, and ventral margins. Length, .77 mm.; height, .49 mm.; thickness, .39 mm.

Plesiotype.—Indiana University Paleontological Collections No. 2072.

Hoxbar formation, abundant at locality 55, shale about 75 feet above Westheimer member, six miles south and two and one-half miles east of Ardmore, Oklahoma. Also locality 60, Hoxbar, locality 78, Deese?, and localities 162, 163, Dornick Hills formation.

Genus NUFERELLA, n. gen.

Genotype, *Nuferella infrequens,* n. sp.

Carapace small, subrhomboidal in lateral outline, with slight forward swing; hinge line long, straight, not depressed; anterior height much greater than posterior height; right valve largest, overlapping left at least on ventral margin; sulcus prominent, located near the middle of the carapace, bordered anteriorly by a low but distinct node; a round tubercle is present in the posterior cardinal area.

This genus somewhat resembles *Jonesina* and *Hollinella*. It differs from the former by having the sulcus located near the middle, by the long non-depressed hinge line, and by the postero-cardinal tubercle. It resembles *Hollinella* in the Beyrichian sulcus but has a node only on one side of the sulcus, shows decided overlap, and differs in lateral outline. The extremity minute size would be unusual for either genus.

This genus is named for Mr. Dan Nufer, Carter Oil Company, Tulsa, Oklahoma.

Nuferella infrequens, n. sp. Plate 3, figs. 4a, b

Carapace very small, subrhomboidal in lateral view, with forward swing; hinge line long, straight, not depressed; anterior cardinal angle obtuse, but distinct; posterior cardinal angle rounded, indistinct; greatest height about the middle of anterior half; greatest thickness slightly posterior to middle; greatest length near median, axis oblique, converging posteriorly on hinge line; anterior end broadly rounded, greatest convexity low; posterior end narrow, blunt, truncate; ventral border convex; sulcus distinct, loop-like, bordered anteriorly by a low, but distinct rounded node; a second very faint sulcus may be seen between this node and the antero-cardinal angle, being accentuated somewhat by a very tiny bead in that corner of the valve; about one sixth the length from the posterior end a small rounded tubercle arises from the rather sharp dorsal convexity of the valve; right valve overlapping the left ventrally, overlap becoming imperceptible at the ends; surface smooth to very finely granulose; color brown. Length, .48 mm.; height, .27 mm.; thickness, .19 mm.

Holotype.—Indiana University Paleontological Collections No. 2077.

Hoxbar formation, locality 60, about 75 feet above the Westheimer member, six miles south, and two and one-fourth miles east of Ardmore, Oklahoma. Also at locality 78 (Deese?) .6 mile north of Deese School.

This tiny but striking ostracode is apparently quite rare, but even so it may be a valuable horizon marker. It has been found at two localities which may be much nearer the same horizon than has hitherto been suspected, one locality being mapped in the Hoxbar formation, while the other locality has been mapped as Deese.

Family BEYRICHIIDAE Jones

Nearly equivalved complexly ornamented Ostracoda which are semiovate to subrhomboidal in lateral view. The hinge line is long and straight, and teeth may be present in the cardinal angles. The valve surface is sulcate and lobed, and may be either smooth, reticulate, or papillate. A marginal frill may or may not be present.

Genus HOLLINELLA Coryell, 1928

Hollinella Coryell, 1928, Jour. Pal., vol. 2, p. 378. —Kellett, 1929, Jour. Pal., vol. 3, pp. 196-200.

Semi-ovate to subrhomboidal carapaces with long straight hinge lines, and nearly equal valves. In the upper part of the valve, near the middle, is a sulcus which is bordered anteriorly by a large hemispherical node, and posteriorly by a much smaller node. A frill may or may not be present on the ventral and posterior margins of the valve. The surface is finely to coarsely papillose.

Hollinella gibbosa Kellett Plate 2, fig. 1

Hollinella gibbosa Kellett, 1929, Jour. Pal., vol. 3, p. 207, pl. 25, fig. 3c. (Emporia? limestone, Wamego County, Kansas.)

Carapace semi-ovate; hinge linge straight; anterior end slightly rounded; posterior obliquely truncated dorsally; a row of beads borders the edge of valve, becoming very prominent on anterior margin above the anterior end of the frill; sulcus slightly posterior to center; anterior node very large and hemispherical; posterior node small, but elevated; ridge beneath sulcus prominent, curved, inflated; frill large and rolled inward; surface covered with a regular arrangement of extremely fine granulations, and a few rounded papillae. Length, 1.6 mm.; height, .96 mm.

Plesiotype.—Indiana University Paleontological Collections No. 2128.

Deese (?) formation, locality 80, about eight miles northwest of Ardmore, Oklahoma.

Hollinella ulrichi (Knight) Plate 2, fig. 4

Beyrichia ? radiata Ulrich and Bassler (not Jones and Kirkby), 1906, Proc. U. S. Nat. Mus., vol. 30, p. 156, pl. 11, fig. 5. (Cottonwood shales, Chase County, Kansas.)

Hollina radiata Ulrich and Bassler, 1908, Proc. U. S. Nat. Mus., ,vol. 35, p. 315, pl. 42, fig. 18.

Hollina ulrichi Knight, 1928, Jour. Pal., vol. 2, p. 237. (New name applied to misidentified species from Upper Fort Scott limestone, St. Louis County, Missouri.)

Hollinella digitata Kellett, 1929, Jour. Pal., vol. 3, p. 209, pl. 26, fig. 1. (Cottonwood limestone, Garrison shales, Wreford limestone, Kansas.)

Hollinella ulrichi (Knight), Kellett, 1933, Jour. Pal., vol. 7, p. 70.

Carapace semi-ovate in lateral view; hinge line straight; greatest length about central; anterior node large, bulbous; median sulcus conspicuous, bifurcating to pass under each node; posterior node smaller, oval-shaped, merging postero-dorsally into convexity of valve; posterior sulcus starting downward immediately back of posterior node, but not joining backward swing of median sulcus; outward curving frill imbricated at edge, extending about half way between median and posterior-cardinal angle around to the antero-ventral region where it terminates in a curved spine; surface distinctly and regularly papillose, with several larger spine-like papillae irregularly distributed. Length, 1.16 mm.; height, .67 mm.

Plesiotype.—Indiana University Paleontological Collections No. 2026.

Hoxbar formation, Daube limestone, locality 8, six miles south and three miles east of Ardmore, Oklahoma.

Hollinella cf. pulchra (Moore) Plate 2, figs. 2, 3

Basslerina pulchra Moore, 1929, Denison University Bull., Jour. Sci. Lab., vol. 24, p. 109, pl. 6, fig. 5, pl. 7, figs. 1, 2, pl. 8 figs. 1, 2. (Cisco Group Pennsylvanian, Texas.)

Carapace short, semi-ovate; only slight backward swing; both cardinal angles obtuse; anterior node large, hemispherical, bulbous, but not extending above the hinge line; posterior node about one-third as large, but distinct, separated from anterior node by narrow deep sulcus, which spreads out below both nodes; frill large, rounded, incurving with distinct radiate markings, curved rather sharply upward at anterior termination; surface granulose. Length, 1.15 mm.; height, .76 mm.

Plesiotype.—Indiana University Paleontological Collections No. 2127.

Deese formation, uppermost part, locality 79, about eight miles northwest of Ardmore, and .7 mile north of Deese, Oklahoma.

A form which may represent a narrow frilled member of this species was found near the same horizon at locality 85; No. 2129, Indiana University Paleontological Collections.

Hollinella kellettae Knight, in Kellett, 1933

Hollina ulrichi Knight, 1928, Jour. Pal., vol. 2, p. 237, pl. 31, figs. 4a, b. (Upper Fort Scott limestone, St. Louis County, Missouri.)

Hollinella ulrichi Warthin, 1930, Okla. Geol. Surv., Bull. 53, p. 56, pl. 4, figs. 6a, b. (Wewoka and Wetumka, east-central Oklahoma.)

Hollinella kellettae Knight, Kellett, 1933, Jour. Pal., vol. 7, p. 70. (Discussion of *Hollinella ulrichi.*)

A number of broken specimens referable to this species have been found. It is best recognized by the more or less regular development of larger papillae, or short spines on the already papillose surface.

Deese formation, upper part, above the Arnold limestone. Fragments most abundant at locality 98, about eight miles northwest of Ardmore, Oklahoma, and locality 126, three and one-half miles south of Ardmore.

Genus HOLLITES Coryell and Sample, 1932

Hollites Coryell and Sample, 1932, Am. Mid. Nat., vol. 13, No. 5, p. 252.

Genotype, *Hollites papillosus,* Coryell and Sample, 1932, op. cit., p. 252, pl. 24, fig. 9.

Hollites ? sp. Plate 2, figs. 5a, b

A specimen which may belong to this genus was found at locality 13, Union Dairy limestone, at the south edge of Ardmore, Oklahoma. It is rather poorly preserved and may be exfoliated. The loop-like ridge around the sulcus is present, but the original character of the valve surface cannot be determined. Length, .61 mm.; height, .34 mm.; thickness, .27 mm.

Specimen.—Indiana University Paleontological Collections No. 2056.

Family KIRKBYIDAE Ulrich and Bassler, 1923

The genera *Kirkbya, Ulrichia, Amphissites, Knightina, Roundyella,* n. gen., and *Scaberina,* n. gen., present many species which are difficult to orientate. The genera *Kirbya* and *Knightina,* however, have carapaces which are comparable in lateral and dorsal outlines to Mesozoic and Recent species. Compare in text Fig. 3 the outlines of *Cythere dictyon* Brady and *Knightina texana* (Harltan). Both are higher and thinner anteriorly, and lower and thicker posteriorly with the more prominent shoulder facing the rear, when the Paleozoic forms are correctly orientated. This was the orientation used by Jones for *Kirkbya* and should certainly be considered the correct one. Correlation of the nodes and kirkbyan pit makes possible the correct orientation of many species of *Amphissites.* With these species the anterior end is usually, although not always the higher, and the swing is usually slightly forward. There are several species, however, where the ends are almost identical. The posterior node is usually the more prominent, and the kirkbyian pit should lie immediately below and slightly posterior to the median node. The genera *Roundyella* and *Scaberina* present difficulties. The ends of the former are almost identical, and the nodes are not developed. *Scaberina* is orientated so that the higher end is anterior and the slight swing is forward.

Genus KIRKBYA Jones, 1859

Kirkbya Jones, 1859, Trans. Tynside Field Club, vol. 4, pp. 129, 134, 136. —Knight, 1928, Jour. Pal., vol. 2, pp. 246-52. —Roth, 1929, Pub. Wagner Free Inst. Sci., vol. 1, pp. 3-14. —Kellett, 1933, Jour. Pal., vol. 7, pp. 84, 85.

In all descriptions under this genus the conventional orientation is reversed, the most acute cardinal angle being taken as the posterior one, thus placing the prominent shoulder in the posterior quarter.

Kirkbya bendensis Harlton Plate 3, fig. 5

Kirkbya bendensis Harlton, 1933, Jour. Pal., vol. 7, p. 22, pl. 6, fig. 2. (Johns Valley shale, southeastern Oklahoma.)

Carapace elongate, subquadrate in lateral view; length more than twice the height; hinge line straight, more depressed on some specimens than on others; anterior and posterior ends rather squarely rounded, posterior margin meeting hinge line with a sharp angle of about ninety degrees; anterior margin meeting hinge line with a slightly obtuse and less distinct angle; ventral border nearly straight; marginal carina pronounced, becoming thicker and more rounded in older specimens; in some specimens the sharp corner of the flange at the posterior cardinal angle is drawn out slightly into a flattened ear-like spine; posterior shoulder flattened, indistinct; pit slightly oval, located postero-ventrally of center and surrounded by about nine reticulations; reticulations distinct on larger specimens, less distinct on smaller ones, without order, except in the posterior quarter where they tend to parallel the margin. Length, .9 mm.; height, .4 mm.

Plesiotype.—Indiana University Paleontological Collections No. 2152.

Dornick Hills formation, locality 162, shale one foot below Otterville limestone, about two miles northwest of Berwyn, Oklahoma. Also locality 161, about 50 feet below the Otterville limestone.

Kirkbya obliqua, n. sp. Plate 3, fig. 8

Carapace elongate, obliquely semicircular in side view; inflated, posterior dorsal shoulder prominent, extending well above the straight, depressed hinge line; ventral margin convex throughout, greatest convexity antero-ventral where it rounds upward into the gently curved anterior border; posterior end high, narrow, near the cardinal angle; both cardinal angles sharp, slightly obtuse; greatest length well above center, nearly parallel to hinge line; greatest height central, although it looks to be anterior due to the obliquity of outline; (greatest distance between hinge line and ventral edge of valve when measured from inside lies one-third the length from the anterior end); two flanges separated by four rows of small reticulations, first flange small, indistinct, inner flange very wide, almost completely obscuring outer flange and ventral margin; pit deep, elongate, cleft-like, situated in a broad oval ring, surrounded by 12-14 reticulation pits; reticulations small except on inner side of upper flange where they are large and elongate. Length, 1.05 mm.; height, .53 mm.

Holotype.—Indiana University Paleontological Collections No. 2055.

Hoxbar formation, Union Dairy limestone, locality 13, Railroad cut south edge of Ardmore, Oklahoma.

This form somewhat resembles *Kirkbya clarocarinata* Knight but differs in the very wide inner flange, and pit, which is not round but elongate. The posterior end is more oblique than that of *K. valida* Kellett.

Kirkbya jolliffana, n. sp. Plate 3, fig. 6

Carapace elongate, length only slightly less than twice the height; hinge line straight, depressed; anterior cardinal angle slightly obtuse and posterior angle slightly acute, giving carapace slight forward swing; ventral margin nearly straight at central half; and margins gently rounded, greatest marginal convexity where end margins round into ventral margin; two very distinct flanges with four rows of recticulations between them; three nodes discernible, posterior one distinct with prominent posterior shoulder, anterior node low and broad, median node marks point of greatest thickness and is separated from the other two by shallow sulci; greatest length obliquely from antero-ventral margin to postero-cardinal extremity; greatest height central or slightly anterior thereto; kirkbyan pit slightly anterior to center, about the size of two reticulations, elongate horizontally and surrounded by eight reticulations; reticulations rather coarse, very deep, distinct, larger and radially elongate on upper inner edge of second flange. Length, 1.14 mm.; height, .59 mm.

Holotype.—Indiana University Paleontological Collections No. 2125.

Dornick Hills formation, Joliff ? limestone, locality 160, about two miles northwest of Berwyn, Oklahoma. Also at localities 148, 162, Otterville limestone.

Kirkbya cf. inornata Roth Plate 3, fig. 10

Kirkbya inornatum Roth, 1929, Pub. Wagner Free Inst. Sci., vol. 1, p. 14, pl. 1, figs. 1a-c. (Wapanucka limestone, Pontotoc County, Oklahoma.)

Carapace similar in outline to *K. jolliffana*, n. sp., in lateral view, but more subrectangular; length twice height; nodes not developed; false keels apparently merged together in a broad rim with steep slope on inner side; pit indistinct, small, oval-shaped, centrally located; reticulations indistinct, shallow, but apparently quite regular. Length, .83 mm.; height, .42 mm.

Plesiotype.—Indiana University Paleontological Collections No. 2122.

Dornick Hills formation, Otterville limestone, locality 146, seven miles south of Ardmore, Oklahoma.

A poorly preserved specimen, but the only one free enough from calcareous deposit to be of use. At some localities the Ostracoda from this horizon are so coated with calcium carbonate that they are entirely worthless.

Kirkbya, n. sp. Plate 3, fig. 7

Carapace shaped similar to that of *K. jolliffana* n. sp., but much smaller in size; two distinct flanges, wide apart, separated by four rows of reticulations obliquely arranged, lower flange clearly visible; pit and reticulations indistinct because of calcareous deposit; pit appears to be round or oval and surrounded by seven or eight reticulations. Length, .6 mm.; height, .32 mm.

Specimen.—Indiana University Paleontological Collections No. 2124.

Dornick Hills formation, Otterville limestone, locality 146, seven miles south of Ardmore, Oklahoma.

Genus ULRICHIA Jones, 1890

Ulrichia Jones, 1890, Quart. Jour. Geol. Soc. London, vol. 46, p. 543, text figure 2.

Genotype, *Ulrichia conradi* Jones, Hamilton formation, Thedford, Ontario, Canada.

The Carboniferous Ulrichia seems to be more closely related to the Carboniferous Kirkbyidae than to the Devonian genotype, and may not be congeneric with it.

Ulrichia montosa Knight Plate 3, figs. 9, 11a, b, c

Ulrichia montosa Knight, 1928, Jour. Pal., vol. 2, p. 252, pl. 32, fig. 1; pl. 33, fig. 1. (Fort Scott limestone, St. Louis County, Missouri.) —Warthin, 1930, Okla. Geol. Surv. Bull. 53, p. 62, pl. 4, fig. 13. (Wewoka and Wetumka formations, east-central Oklahoma.)

Carapace elongate, subquadrate to semicircular in lateral view; hinge line as long as total length, not depressed; some valves show decided obliquity in which case the most acute cardinal angle is posterior; anterior and posterior margins gently convex meeting dorsal margin at nearly right angles; ventral border nearly straight and parallel to dorsal margin at middle portion; two distinct non-reticulate flanges separated by about four or five rows of reticulations, converging toward cardinal angles; two rounded nodes arise from each half of the valve surface, the posterior one usually being the highest, protruding most above the dorsal margin; valves nearly equal, the right slightly larger than the left; surface finely reticulate; a very faint costa may sometimes occur just below the nodes. Length, 1.21 mm.;

height, .6 mm.; thickness, .5 mm.

Plesiotype.—Indiana University Paleontological Collections No. 2063.

Deese formation, Devils Kitchen member, locality 69, seven miles south and one mile east of Ardmore, Oklahoma.

A figured specimen from the Anadarche limestone, locality 3, six miles south, three miles east of Ardmore, appeared to be about average size for that horizon and had the following measurements: Length, .78 mm.; height, .41 mm.

Plesiotype.—Indiana University Paleontological Collections No. 2060.

The species seems to show considerable variation in the obliquity of the valves, and development of the nodes.

Genus AMPHISSITES Girty, 1910

Amphissites Girty, 1910, Ann. N. Y. Acad. Sci., vol. 20, p. 235. —Knight, 1928, Jour. Pal., vol. 2, pp. 246-52. —Roth, 1929, Pub. Wagner Free Inst. Sci., vol. 1, pp. 32-6. —Kellett, 1933, Jour. Pal., vol. 7, p. 93.

Genotype, *Amphissites rugosus* Girty, 1910, op. cit., p. 236.

In accordance with the views set forth earlier in this paper, the orientation of this genus is reversed from that ordinarily employed. The largest node or most prominent shoulder is considered posterior, in which case the right valve would bear the teeth, and the left the sockets, the pit lying usually on the postero-ventral side of the median node instead of the antero-ventral side as formerly.

Amphissites rugosus Girty Plate 3, fig. 12

Amphissites rugosus Girty, 1910, Ann. N. Y. Acad. Sci., vol. 20, p. 236. (Fayetteville shale, Fayetteville Quadrangle, Arkansas.) —Roundy, 1926, U. S. P. P. 146, p. 7 pl. 1, fig. 1 (holotype). —Harlton, 1933. Jour. Pal., vol. 7, p. 22, pl. 6, figs. 5a-d. (Johns Valley shale, southeastern Oklahoma.)

Amphissites weaveri Roth, 1929, Pub. Wagner Free Inst., vol. 1, p. 39, pl. 2, figs. 11a-c. (Basal Fayetteville formation, Mayes County, Oklahoma.)

Carapace subquadrate in lateral view; dorsal and ventral margins nearly straight, and connected by gently convex, and nearly equally rounded end margins; cardinal angles less obtuse than average for the genus, and hinge line long in proportion to total length; non-reticulated marginal frill running from one angle to the other; first inner costa about three reticulations above and roughly parallel to outer frill, tending to converge antero-ventrally with it, either with or without reticulations; second inner costa about three reticulations above the first, divided into two parts, one extending downward from the postero-cardinal area across the posterior shoulder, curving slightly forward, terminating near the median line, the second part beginning near the middle of the shell, curving forward and upward roughly paralle to the first costa and bifurcating on the anterior node; median node rather large, located slightly antero-dorsally of center; pit small, elongated, axis in direction of greatest length of carapace, situated postero-ventrally of median node. Length, .78 mm.; height, .51 mm.

Plesiotype.—Indiana University Paleontological Collections No. 2158.

Dornick Hills formation, Otterville limestone, locality 163, about two miles northwest of Berwyn, Oklahoma.

Examination of several specimens failed to show any in which the inner costa was connected. I doubt if these forms described by Roth, Harlton, and myself are truly conspecific with *A. rugosus* Girty. If so Girty had an unusual rather than an average specimen.

Amphissites marginiferus Roth Plate 3, fig. 14

Amphissites marginifera Roth, 1929, Pub. Wagner Free Inst., vol. 1, p. 45, pl. 3, figs. 14a-c. (Wapanucka limestone, Pontotoc County, Oklahoma.)

Amphissites marginiferus Harlton, 1933, Jour. Pal., vol. 7, p. 23, pl. 6, figs. 3a-b. (Johns Valley shale, southeastern Oklahoma.)

Carapace suboblong in lateral view; cardinal angles very obtuse; hinge line short in proportion to total length of carapace, depressed; ends well rounded, semicircular, a very slight postero-dorsal truncation; greatest height one-fourth the distance from posterior end; greatest length median; dorsal margin concave, ventral margin straight, converging slightly anteriorly toward the hinge line; marginal frill wide, prominent, extending from one angle to the other, a row of faint reticulations on ventral side; first costa two to four rows of reticulations above outer frill, roughly parallel to it but converging on it antero-ventrally. Anterior and posterior nodes carinate; the carina of the first passing downward from the anterior cardinal angle to about the median line and thence backward, roughly paralleling and three reticulations above the first inner costa, dying out under the pit; the latter passing downward from the posterior cardinal area and curving backward slightly as if to join the disappearing end of the anterior costa. Median node large, slightly antero-dorsad of center; kirkbyan pit large, slightly below and elongated in direction of median line, situated on postero-ventral side of median node; reticulations prominent, tending to parallel carinae. Length, .98 mm.; height, .57 mm.

Plesiotype.—Indiana University Paleontological Collections No. 2156.

Dornick Hills formation, shale half way between Otterville limestone and top of Springer formation, locality 155, four miles north and two miles west of Ardmore, Oklahoma.

This form resembles *A. rugosus* in the number and position of the costae. However, the costae are much stronger and the false keel much wider and sharper. It is more strongly reticulated and the outline is somewhat different, the cardinal angles being much more obtuse. It is very close to *A. chappelensis* Roundy, 1926 (U. S. Geol. Surv. Prof. Paper 146, p. 7, pl. 1, fig. 2.) and may be the same.

Amphissites cumingsi, n. sp. Plate 3, fig. 13

Carapace elongate, oblong-subquadrate in lateral view; greatest height anterior; hinge line straight, depressed; dorsal and ventral margins concave; ends broadly rounded, anterior symmetrically, posterior unsymmetrically, with extremity above median line, slightly truncate postero-ventrally; false keel pronounced, thick, rounded, with faint row of reticulations on ventral side; first inner carina short, beginning underneath the uncarinated posterior node, curving downward under the median node and terminating at the lower end of the carina on the anterior node which joins the dorsal carina; dorsal carina distinctly continuous with false keel when viewed from side; all carinae unreticulated; median node slightly anterior dorsal of center, flattened on posterior side; pit situated nearly centrally on postero-ventral side of median node, oval shaped, with axis passing obliquely through the top of the posterior node; reticulations medium in size, not distinct, paralleling carinae. Length, .9 mm.; height, .52 mm.

Holotype.—Indiana University Paleontological Collections No. 2155.

Dornick Hills formation, locality 155, about half way between Otterville limestone and the top of the Springer formation, four miles north and two miles west of Ardmore, Oklahoma. Also at locality 163, Otterville limestone.

This species is named in honor of Prof. E. R. Cumings, Department of Geology, Indiana University, Bloomington, Indiana.

Amphissites rothi, n. sp. Plate 4, fig. 1

Carapace oblong-subquadrate in lateral view, slight forward swing; hinge line straight, rather short; cardinal angles obtuse, anterior one distinct; dorsal margin nearly straight; ventral margin concave; ends smoothly rounded, except for anterior border in the antero-dorsal cardinal area where the margin departs from the regular curve and turns upward at a less obtuse angle to the cardinal angle; greatest height one-fourth the length from anterior extremity; greatest length slightly below median, axis inclined converging posteriorly on the hinge line; posterior node prominent, producing a bulge at posterior cardinal angle and sloping downward and forward from the hinge line, dying out near the median line; anterior node poorly defined; median node large, hemispherical, slightly anterior to center; pit on ventral side of median node, oval shaped, axis in direction of greatest length, below and slightly anterior to center; false keel poorly developed, reticulate, with a row of reticulations on the lower side. No costae, but an elevated area in the antero-ventral portion of the shell, rising about half way between the pit and ventral margin, curving around and upward toward the antero-cardinal angle, broadening meanwhile; reticulation rows follow the elevation with the ridges between them becoming prominent and bifurcating, due to the addition of new rows as the area broadens upwardly; reticulations medium in size, even, distinct. Length, .96 mm.; height, .59 mm.

Holotype.—Indiana University Paleontological Collections No. 2119.

Dornick Hills formation, locality 160, Joliff limestone, ten miles north and four and three-quarters miles east or Ardmore, Oklahoma. Also localities 118, 148, 149, 155, 162, all from the Otterville to the top of the Springer formation.

This species is named for Mr. Robert Roth, Bartlesville, Oklahoma.

Amphissites confluens, n. sp. Plate 4, fig. 2

Carapace large, oblong-subquadrate in lateral view; hinge line long, straight, depressed; cardinal angles obtuse, posterior one distinct; dorsal margin nearly straight for most part, postero-dorsal bulging causes slight convexity with the line dropping downward slightly to the cardinal angle; ventral margin nearly straight for the greater part, converging posteriorly toward the hinge line; ends smoothly rounded; greatest height one-fourth distance from anterior extremity; greatest length median; posterior and median nodes joined in one large, smooth, elongate node, obliquely situated; anterior node low, flat, indistinct; pit on lower side of postero-median node, postero-ventral of center, oval shaped, axis slightly inclined to median line; slightly, reticulated costa developed beneath pit paralleling ventral border; false keel small, unreticulated, with a very faint row of reticulations on the ventral side along the central half of the shell; reticulations small, indistinct.

Length, 1.02 mm.; height, .6 mm.

Holotype.—Indiana University Paleontological Collections No. 2157.

Dornick Hills formation, locality 155, about half way between the Otterville limestone and the top of the Springer formation, four miles north, two miles west of Ardmore, Oklahoma. Also at locality 162, immediately below the Otterville limestone.

This species is distinguished by its large size, smoothness, and coalescing of posterior and median nodes.

Amphissites alticostatus, n. sp. Plate 4, fig. 4

Carapace oblong-subquadrate in lateral view; hinge line depressed; dorsal margin very concave; cardinal angles about equally obtuse; ventral margin straight to slightly concave; ends about equally rounded, greatest convexity at and below median line, tending to straighten out above; greatest height across anterior node; greatest length about median; first false keel sharp, pronounced, conspicuously continuous completely around the margin of the valve, giving rise at the top of the anterior and posterior nodes to high sharp carinæ which extend downward and die out at or just above the median line; second keel or inner flange begins just below the median line about half way between the lowest extension of the carina on the posterior node and the marginal keel, and runs around the carapace paralleling the outer keel to a corresponding point at the opposite end where it becomes inconspicuous but may be traced nearly to the cardinal angle; median node small, but steep on postero-ventral side, with a short, high, sharp, slightly curved costa crossing it at right angles to the median line; all carinæ free of reticulations; pit small, oval, situated on the postero-ventral side of the median node; reticulations rather large and distinct; paralleling carinæ; six or eight tiny, node-like spines arranged in circular fashion about the median node. Length, .57 mm.; height, .36 mm.

Holotype.—Indiana University Paleontological Collections No. 2153.

Dornick Hills formation, locality 161, shale about 50 feet below Otterville limestone, about two miles northwest of Berwyn, Oklahoma. Also locality 162, shale immediately below Otterville limestone.

This species reminds one considerably of *A. cumingsi,* n. sp. but it is much smaller, more subquadrate, the carinæ are sharper and much higher, all nodes being carinated, whereas in *A. cumingsi,* n. sp., the median and posterior nodes are not carinated. The distinctive feature here is the extremely high carinæ which make the valve surface appear as depressions rarely free from extraneous material.

Amphissites centronota[23] (Ulrich and Bassler) Plate 4, fig. 3

Kirkbya centronota Ulrich and Bassler, 1906, Proc. U. S. Nat. Mus., vol. 30, p. 159, pl. 11, figs. 16, 17. (Cottonwood shale, Chase County, Kansas.)

Amphissites centronota Harlton, 1927, Jour. Pal., vol. 1, p. 207, pl. 32, fig. 10. (Hoxbar formation, Carter County, Oklahoma.)

Amphissites centronotus Knight, 1928, Jour. Pal., vol. 2, p. 259, pl. 32, fig. 6, pl. 34, fig. 2. (Fort Scott limestone and Labette shale, St.

---

[23] Centronota is a feminine noun meaning central mark or sign and therefore should not be given an adjectival ending.

Louis County, Missouri.) —Warthin, 1930, Okla. Geol. Surv., Bull. 53, p. 66, pl. 5, figs. 4a, b, c. (Wetumka [abundant], Wewoka, Holdenville, east-central Oklahoma.) —Delo, 1930, Jour. Pal., vol. 4, p. 160, pl. 12, fig. 9. (Ft. McKavett, Tisdall No. 1, depth 1730-50 feet.) —Coryell and Osorio, 1932, Am. Mid. Nat., vol. 13, No. 2, p. 30. (Nowata shale, Tulsa County, Oklahoma.) —Coryell and Billings, 1932, Am. Mid. Nat., vol. 13, No. 4, p. 184, pl. 18, fig. 9. (Wayland shale, five miles east of Cisco, Texas.) —Coryell and Sample, 1932, Am. Mid. Nat., vol. 13, No. 5, p. 258, pl. 25, fig. 1. (East Mountain shale, Mineral Wells, Texas.)

Amphissites centronota var. *transversa* Roth, 1929 Pub. Wagner Free Inst. Sci., vol. 1, p. 52, pl. 3, figs. 17a, b, c. (Contact Hogshooter limestone and Nellie Bly formation, Tulsa County, Oklahoma.)

Carapace suboblong or oblong-subquadrate in lateral view; cardinal angles slightly obtuse; greatest height central or slightly posterior of center, greatest length median or slightly above; hinge line straight, slightly less than maximum length, depressed; dorsal margin irregular, controlled by the dorsal carina; ventral margin and the two ends form a continuous semicircular arc. Carinae highly developed; two prominent flanges extending from one cardinal angle to the other; inner flange continuous with the highly developed dorsal keel; position of anterior and posterior nodes indicacted by outwardly curving carinæ extending downward from the dorsal keel, dying out near the level of the kirkbyan pit; median node very large, central, hemispherical in shape; kirkbyan pit curved, subelliptical in shape, on lower side of median node slightly posterior of center; entire surface except margin and carinæ distinctly reticulated, smaller in size on the median node, arrangement roughly concentric toward the margins. Length, .89 mm.; height, .57 mm.

Plesiotype.—Indiana University Paleontological Collections No. 2118.

Deese formation, locality 79, about eight miles northwest of Ardmore, Oklahoma. Also localities 1, 14, 47, 53, 85, and 98.

This is a rather abundant and wide spread form, both stratigraphically and geographically. Varieties may eventually be recognized which will be useful for stratigraphical work. *Amphissites centronota* var. *transversus* Roth, 1929, has already been separated. Only further study will show whether this has been justified.

At locality 1, Anadarche limestone, there occurred specimens of a very elongate variety of this species. No typically proportioned *A. centronota* was found with them.

Amphissites girtyi, var. deesensis, n. var. Plate 4, fig. 5

Carapace subquadrate in lateral view; ends rounded; posterior cardinal angle more obtuse than anterior; greatest height posterior, giving a backward swing to carapace; hinge line straight, depressed; anterior and posterior nodes giving saddle effect to dorsal margin; ventral margin nearly straight; inner flange dies out short of the cardinal angle, approaching nearer at the anterior end; anterior and posterior nodes with well developed roughly parallel carinæ, slanting obliquely forward and downward; posterior carina longest, starting at a point midway between the lower side of the pit and the posterior margin and curving upward to the posterior cardinal area where it bifurcates noticeably before passing over the shoulder to meet the dorsal carina; anterior carina about half the length of the posterior, dying out about the level of the top of the median node; median node small in diameter, but high, and usually drawn out antero-ventrally into a thin short ridge or carina which slants obliquely downward and more forward than either of the other carinæ; pit on the postero-ventral side of the median node; entire surface, except margin and carinæ, reticulated. Length, .91 mm.; height, .54 mm.

Holotype.—Indiana University Paleontological Collections No. 1997.

Deese ? formation, locality 80, about eight miles northwest of Ardmore, Oklahoma.

This form is probably distinct enough to be given the rank of species, but for correlation purposes its close relationship to *A. girtyi* Knight, and *A. mesocosta* Roth can best be emphasized by making it a variety of *A. girtyi.*

Amphissites pinguis (Ulrich and Bassler) Plate 4, fig. 6

Kirkbya pinguis Ulrich and Bassler, 1906, Proc. U. S. Nat. Mus., vol. 30, p. 159, pl. 11, figs. 13-15. (Cottonwood shales, two miles east of Cottonwood Falls, Kansas.)

Amphissites pinguis Knight, 1928, Jour. Pal., vol. 2, p. 263, pl. 32, fig. 9, pl. 34, fig. 3. (Fort Scott limestone, St. Louis County, Missouri.) —Kellett, 1933, Jour. Pal., vol. 7, p. 94, pl. 15, figs. 12-22, 41. (Middle and Upper Pennsylvanian, Kansas.)

Amphissites genae (*geni*) Roth, 1929, Pub. Wagner Free Inst., vol. 1, p. 42, pl. 2, fig. 12. (Francis shale, Pontotoc County, Oklahoma.) — Warthin, 1930, Okla. Geol. Surv., Bull. 53, p. 64, pl. 5, fig. 2. (Holdenville, central-eastern Oklahoma.)

Carapace oblong-subquadrate in lateral view; greatest length and height central; dorsal and ventral margins nearly straight, joined by the symmetrically and almost equally curved anterior and posterior margins; cardinal angles obtuse and subequal; surface noding poorly developed; low shoulder or bulge developed in dorso-posterior region curved in harmony with posterior margin; central node low, poorly defined, truncated on posterior ventral side where it overhangs the large, obliquely situated kirkbyan pit, which is about three reticulations in length; reticulations medium in size, distinct, regular; false keel present, low unreticulated; second or inner one represented by high area on ventral margin of shell. Length, .76 mm.; height, .46 mm.

Plesiotype.—Indiana University Paleontological Collections No. 2020.

Hoxbar formation, Union Dairy limestone, locality 13, Railroad cut south edge of Ardmore, Oklahoma. Also locality 74, about eight miles northwest of Ardmore.

Amphissites edsonæ, n. sp. Plate 4, fig. 7

Carapace small, oblong-subquadrate in lateral view; hinge line straight, depressed; cardinal angles about equally obtuse; greatest height anterior; greatest length median; dorsal margin relatively straight; ventral margin straight at middle half, converging posteriorly on hinge line; posterior margin symmetrically rounded; anterior more broadly rounded than posterior, and slightly more convex at point of greatest forward extension; posterior node well developed, greatest length at right angles to hinge line, steep posteriorly, sharp at summit but completely reticulated; anterior and median nodes indistinct; median node marked postero-ventrally by a sharp depression in which the oval pit is obliquely situated, slightly below the center of the carapace, with the axis of elongation passing through the top of the posterior node; marginal carina well developed, without reticulations; no inner costæ developed; reticulations small, regular, paralleling false keel near the margin. Length, .58 mm.; height, .34 mm.

Holotype.—Indiana University Paleontological Collections No. 2120.

Hoxbar formation, locality 53, about 200 feet above the Westheimer member, six miles south and two and one-half miles east of Ardmore, Oklahoma.

This species has been found at only one horizon, and is represented in the author's collections by about a dozen specimens. It has been derived directly from *A. dattonensis* Harlton by the loss of the transverse carina below the pit.

This species is named for Mrs. Fanny Edson, Tulsa, Oklahoma.

Amphissites dattonensis Harlton Plate 4, figs 9a, b, c

Amphissites dattonensis Harlton, 1927, Jour. Pal., vol. 1, p. 206, pl. 32, figs. 9a, b. (Upper Deese, Carter County, Oklahoma.) —Harlton, 1929, Univ. of Texas, Bull. 2901, p. 149, pl. 1, figs. 9a, b. (Canyon, Menard County, Texas.) —Warthin, 1930, Okla. Geol. Surv., Bull. 53, p. 64, pl. 4, fig. 15. (Holdenville, Wewoka, Wetumka, east-central Oklahoma.) —Coryell and Billings, 1932, Am. Mid. Nat., vol. 13, p. 184, pl. 18, fig. 8. (Wayland shale, five miles east of Cisco, Texas.) —Coryell and Sample, 1932, Am. Mid. Nat., vol. 13, p. 260, pl. 25, fig. 2. (East Mountain shale, Mineral Wells, Texas.)

Carapace small, subquadrate to suboblong in lateral view; dorsal margin concave in middle, convex over anterior and posterior nodes; hinge line straight, depressed; anterior and posterior margins broadly rounded; ventral margin nearly straight, but sometimes slightly convex or concave; carinæ well developed, outer one at free margin, second paralleling this running from one cardinal angle to the other and merging into the dorsal keels, a third inner one parallel to this last, beginning near the median line at the anterior end and running around underneath the pit, dying out below the lower end of the fourth carina which extends vertically across the posterior node; only posterior node well developed, with very steep shoulder on the posterior side; median node inconspicuous, with sharp sinus on postero-ventral side in which the oval pit is situated; a row of three or four spines may be present inside the second carina, beginning just below the end of the third carina, and extending outward and upward to the second carina; surface evenly reticulated. Length, .76 mm.; height, .47 mm.; thickness, .38 mm.

Plesiotype.—Indiana University Paleontological Collections No. 2052.

Hoxbar formation, just above Daube limestone, locality 5.

A rather widely ranging form and a common one throughout the Hoxbar, and especially abundant near the horizon of the Daube limestone. It should be watched carefully for variations in order to increase its stratigraphic value.

Genus KNIGHTINA Keilett, 1933

Knightina Kellett, 1933, Jour. Pal., vol. 7, p. 97.

Knightina texana (Harlton) Plate 4, fig. 8

Kirkbya texana Harlton, 1928, Jour. Pal., vol. 2. p. 136, pl. 21, figs. 6a, b. (Cisco, Eastland County, Texas.)
Amphissites ? texanus (Harlton), 1929, Univ. of Texas, Bull. 2901, p. 149, pl. 1, fig. 11. (Canyon, Menard County, Texas.)
Knightina texana Kellett, 1933, Jour. Pal., vol. 7, p. 100, pl. 16, figs. 23-28. (Permian of Kansas.)

Carapace sub-oblong in lateral view, hinge line straight, impressed, long in proportion to greatest length of carapace; dorsal margin straight or very slightly concave; ends nearly equally rounded, anterior wider than posterior, and meeting the straight ventral margin at a rounded, obtuse angle antero-ventrally; cardinal angles obtuse, equal; left valve slightly smaller than right. False keels or flanges, two in number, passing from one cardinal angle to the other; reticulations (two rows) between the two flanges, none between the outer flange and free margin; nodes non-carinate; posterior node most prominent, having a rather sharp shoulder posteriorly; anterior node low, connected to posterior by low dorsal ridge and the elongate curved median node. The depressed area above the median node causes the three elongate, ridge-like, connected nodes to assume the appearance of the Greek letter Sigma. Reticulations large; pit large but shallow, oval in shape, axis oblique to greatest length of carapace, situated subcentrally in the curved depression below the elongate median node and surrounded by seven to ten reticulation pits. Length, .77 mm.; height, .42 mm.

Plesiotype.—Indiana University Paleontological Collections No. 2121.

Abundant in the lower Hoxbar, locality 53, shale 200 feet above the Upper Westheimer member, six miles south and two and one-half miles east of Ardmore, Oklahoma. A variety altogether similar but with less relief occurs at locality 126. The specimen figured is a large individual.

The distinction between *K. texana* (Harlton) and *K. allorismoides* (Knight) was rather hazy until the recent descriptions by Miss Kellett (Jour. Pal., vol. 7, 1933). The chief difference seems to be in the width between the false keels, the width being somewhat greater in *K. allorismoides,* with three rows of reticulations instead of two. *Kirkbya perplexa* Roth, 1929 (Pub. Wagner Free Inst., vol. 1, p. 29, pl. 1, figs. 8a-c.) should probably be referred to one of these species, but just which one cannot be determined with certainty from the figures or description.

Knightina kellettæ, n. sp. Plate 4, fig. 10

Carapace elongate, nearly twice as long as high, hinge line long, straight, depressed; greatest height one-third the distance from posterior end; greatest length slightly above middle and oblique to hinge line, converging posteriorly; postero-dorsal shoulder extends high above hinge line; ventral margin nearly straight, with a slight tendency to be concave just anterior to the middle; two false keels developed with three rows of obliquely arranged reticulations between them, and one row of very faint reticulations on ventral side of first keel; posterior shoulder prominent, steep on posterior side, curving forward and downward from the hinge line, then curving backward, lowest point about one-third the height from the ventral margin. A ridge extends forward from the lower part of the posterior node, curving up over the pit, then down, then obliquely upward toward anterior cardinal area, producing an inclined Greek letter Sigma. The large pit is centrally located, oval, with the axis pointing toward the posterior cardinal angle and is surrounded by about eight reticulation pits, which are separated from it by a distinct rim. Reticulations distinct, paralleling the false keels. Length, .88 mm.; height, .46 mm.

Holotype.—Indiana University Paleontological Collections No. 2154.

Dornick Hills formation, locality 162, shale one foot below Otterville limestone, about two miles northwest of Berwyn, Oklahoma.

This species is named in honor of Miss Betty Kellett who recently erected the genus.

Genus ROUNDYELLA, n. gen.

Genotype, *Roundyella simplicissimus* (Knight).

Amphissites simplicissimus Knight, 1928, Jour. Pal., vol. 2, p. 266, pl. 32, fig. 11, pl. 34, fig. 6. (Upper Fort Scott limestone, St. Louis County, Missouri.) —Harlton, 1929, Univ. Texas, Bull. 2901, p. 151, pl. 1, figs. 13a-c. (Canyon Group, Menard County, Texas.) —Warthin, 1930, Okla. Geol. Surv., Bull. 53, p. 67, pl. 5, figs. 1a, b. (Wetumka to Holdenville, east-central Oklahoma.) —Delo, 1930, Jour. Pal., vol. 4, p. 158, pl. 12, figs. 8a, b. (Carboniferous, deep well, Menard County, Texas.)

Carapace suboblong in lateral view; greatest thickness about central; greatest length about median; hinge line long, straight, depressed; dorsal margin straight; cardinal angles about equally obtuse; teeth and sockets poorly developed; ends equally rounded; ventral margin nearly straight, roughly paralleling dorsal margin; noding and costæ undeveloped, flanges obsolete; surface reticulated; shallow, round to oval pit near center of valve.

This genus may be distinguished from the closely related *Amphissites* by the lack of nodes, costæ, or flanges, the nearly parallel dorsal and ventral margins, and more equally rounded ends. The teeth and sockets are also less well developed.

The genus is named for Dr. P. V. Roundy, of the U. S. Geological Survey.

The present known range of this genus is from lowest Pennsylvanian to lower Permian.

Roundyella bellatula, n. sp. **Plate 4, fig. 11**

Carapace elongate, suboblong in lateral view; length twice width; inflated, marginal slopes steep; greatest thickness central or slightly anter-dorsal thereof; hinge line straight, long, depressed; teeth and sockets poorly developed; dorsal margin straight; cardinal angles about equally obtuse; ends equally rounded; ventral margin slightly concave, nearly parallel to dorsal margin; noding undeveloped; very faint indications of first, and possibly second flanges; pit about the size of two reticulations, round to oval, shaped somewhat by the sides of the nine reticulations surrounding it; reticulations large, very irregular in size, shallow, with intervening net-work very well developed, but smooth and without spinelets. Length, .93 mm.; height, .47 mm. Measurements of a smaller specimen are as follows: length, .66 mm.; height, .32 mm.

Holotype.—Indiana University Paleontological Collections No. 2151.

Dornick Hills formation, just below Otterville limestone, locality 162, about two miles northwest of Berwyn, Oklahoma.

The holotype is a very large and probably senile individual. However, it differs little from smaller individuals except that in the latter a slight central node may be observed with the pit on the lower side. The length-height ratio appears to be consistently about two to one, while measurements of *R. simplicissimus* (Knight), the other species now referable to this genus, are according to Knight, Kellett, and Warthin; .65 mm. - .36 mm., .68 mm. - .39 mm., .85 mm. - .46 mm., .66 mm. - .4 mm.

Genus SCABERINA, n. gen.

Genotype, *Scaberina nodomarginata,* n. sp.

Carapace suboblong in lateral view; dorsal and ventral margins more or less parallel; ends rounded; hinge line long and straight like *Roundyella,* n. gen., and *Amphissites;* surface coarsely granulose and covered with bead-like papillæ; marginal ridges may be present.

This genus is like *Amphissites* and *Roundyella,* n. gen. in outline and hinge line. It is not reticulated, however, but has a surface ornamentation unlike that of any Paleozoic ostracode known to the writer.

The known range is Middle Pennsylvanian.

Scaberina nodomarginata, n. sp. Plate 4, figs. 12a, b

Carapace suboblong in lateral view; anterior? end slightly higher than posterior; greatest length median; hinge line long, straight; cardinal angles about equally obtuse, or posterior one slightly larger; teeth and sockets apparently not developed; dorsal margin irregular, slightly higher at the cardinal angles; ventral margin roughly parallel to dorsal margin; ends about equally rounded, posterior? slightly more convex; entire surface coarsely granulose and covered with larger bead-like granulations, or low rounded papillæ; ends of the valves encircled by elevated ridges which curve upward from the ventral margin near the middle and become obscure in the broad, flat, interior area on the valve surface. The beads become prominent on these ridges and are arranged in tiers. Along the edge of the valve the beads are arranged in quite regular rows. Length, .75 mm.; height, .47 mm.

Holotype.—Indiana University Paleontological Collections No. 2019.

Hoxbar formation, Union Dairy limestone, locality 13, Railroad cut south edge of Ardmore, Oklahoma.

This most extraordinary ostracode has been found at only the one horizon, and is represented in the author's collection by four single valves. The first specimen found was thought possibly to be an encrusted specimen of *Roundyella simplicissima* (Knight). However, after three more valves identical with thte first were found, and one was treated with acid under constant observation to detect any indication of reticulation as the outside dissolved away, it became apparent that the granulose bead-covered surface represented the actual valve ornamentation.

Family GLYPTOPLEURIDAE Girty, 1910

Genus GLYPTOPLEURA Girty, 1910

Genotype, *Glyptopleura inopinata* Girty, 1910, Ann. N. Y. Acad. Sci., vol. 20, no. 3, p. 237.

Glyptopleura Coryell and Blackmier, 1931, Am. Mid. Nat., vol. 12, pp. 505-18, pl. 1, 2. —Kellett, 1933, Jour. Pal., vol. 7, p. 74.

Carapace small, subquadrate in lateral view, with a forward swing; posterior end more narrowly rounded than anterior; hinge line straight; valves unequal, the right valve the larger overlapping the left all around except at the hinge line; ornamentation consists of several longitudinal costæ that vary in obliquity, curvature, and size; a pit is located near the center of the valve.

Recent studies seem to indicate that the orientation given by Jones and Kirby in 1886 to species now included in this genus was probably right, and the orientation used by Girty when he erected the genus was probably wrong. The above description is based upon what the writer believes to be the correct orientation.

Numerous fragments representing several species of this genus occur in the writer's collections, but unbroken valves are rare. The only species sufficiently represented for figuring appears to be a new one.

Glyptopleura whitei, n. sp. Plate 4, fig. 13

Carapace small, subquadrate; hinge line straight, forward swing apparent; greatest height posterior to center; anterior margin broadly curved, more convexly in antero-ventral region; posterior end narrower than anterior, but margin broadly rounded; ventral margin convex; cardinal angles rounded; valve surface ornamented by inosculating costæ crossing obliquely from antero-ventral area to dorso-anterior region. These ribs consist of four main ones with three obscure ones between them, in alternating fashion. The second main rib from the ,central margin is the longest and most noticeable. The costæ die out toward the postero-dorsal region so that they become progressively shorter toward the antero-dorsal region. The dorsal region is rather free from costæ except for a single horizontal rib rising as an ear-like process near the postero-dorsal 'angle and fading out anteriorly near the center. The elliptical pit is above the third main rib, and lies above and slightly anterior to the center. Length, .83 mm.; height, .52 mm.

Holotype.—Indiana University Paleontological Collections No. 2148.

Dornick Hills formation, locality 162, ten miles north and five miles east of Ardmore, Oklahoma.

This species is named in honor of Dr. M. P. White, Ardmore, Oklahoma.

Family YOUNGIELLIDAE Kellett, 1933

In this family there are two ,common Pennsylvanian ostracode genera, *Moorites* Coryell and Billings, and "*Moorea*". This so-called *Moorea* is very closely related to *Moorites*, differing only in the presence of an inosculating costa and pits on the valve surfaces of the latter. The shape is the same, both possess the marginal scroll-like ridge, and both have long straight hinges, which, on the inside are serrated from one cardinal angle to the other. These teeth are like those shown for *Youngiella*. For this reason, and the greater similarity in outline, the species which have been referred to *Moorea* seem better placed under *Youngiella*, although the latter genus lacks the marginal ridge. I doubt whether these Pennsylvanian forms are congeneric with *Youngiella*, and they would probably be better placed under a new genus. *Moorites* with its additional surface ornamentation appears to be sufficiently different to constitute another genus.

The genus *Moorea* is discussed as some length, although no species is included under it in this paper.

In accordance with the principles of orientation set forth earlier in this paper the conventional orientation is reversed for the genera here included in this family. The thicker end is taken as posterior, and the swing as forward instead of backwards. The members of this family show the greatest similarities to Recent forms, of any of the oblong-subrhomboidal type. Compare *Cythere falklandi* Brady with *Youngiella? gracilia,* n. sp., (text figure 3) or with *Y.? elongata* (Pl. 4, fig. 14) and other figured species of this family. The resemblance is striking indeed, and some Paleozoic member of this family might well have been the ancestor of the Cytheridæ.

Genus MOOREA Jones and Kirkby, 1869

Moorea Jones and Kirkby, in Moore, 1867, Quart. Jour. Geol. Soc. London, vol. 23, p. 494, 523, 559. Nomen nudum.
Moorea Jones and Kirkby, in Jones and Holl, 1869, Ann. Mag. Nat. Hist., ser. 4, vol. 3, p. 225.

Genotype (first described and figured species), *Moorea silurica* Jones and Holl, 1869, op. cit., p. 226, pl. 15, figs. 8a, b. (Upper Ludlow rocks, Hales End, Malvern, England.)

Some Ostracoda were collected by Mr. Charles Moore from the Carboniferous limestone of Somersetshire. These were given to Jones and Kirby who recognized two species of a new genus, which were named by them in a manuscript, *Moorea obesa* and *M. tenuis.* These names were included by Moore, 1867, op. cit., in some faunal lists, but were unaccompanied by any kind of description or figures.

Jones and Holl refer to the specimens collected by Moore as "a few specimens having simple, thick, flattened carapace-valves, longer on the dorsal than the ventral margin, without any subcentral pit, and ornamented with narrow, rounded ridges, following more or less closely and completely the marginal contour". This then would constitute the real generic description of *Moorea.* Since this is perhaps a little too generalized considering the large number of ostracodes that have been described since that time, a description of the genotype, *Moorea silurica,* follows.

MOOREA SILURICA Jones and Holl

Jones and Holl described this species as follows:

"Carapace-valves subovate, one-third longer than high, slightly convex, polished, but coarsely punctate, and bearing a raised marginal rim. Dorsal edge straight; dorsal corners rounded. Ventral border presenting a nearly true segment of a circle. Ends somewhat obliquely rounded, nearly equal in outline. A stout elevated ridge runs along nearly the whole margin of the valve. It may be said to begin on the hinder edge, which is depressed, but strongly lipped by the marginal rim standing out sharply backwards; it thickens on the ventral border, is very thin anteriorly, and rises high along the dorsal region, until it turns suddenly downwards, to lose itself in the general surface of the posterior third of the valve.

"The ventral border of the figured valve (fig. 8b, probably right and overlapping valve) is flattened suddenly by the projection of the marginal rim, and by being turned inwards for a considerable depth. Its extreme edge has for most of its length a delicate raised rim, which, however, passes outwards and backwards to join the great marginal ridge, where the latter projects as a thick, sharp-edged crest along the posterior edge of the valve."

Only two of the several American species which have been described under the genus *Moorea* should, in the opinion of the writer, be left there. These are *M. punctata* Ulrich and *M. angularis* Ulrich, which are for the present perhaps best referred to that genus. Both species are from the Trenton limestone of Minnesota. *Moorea kirkbya* Jones[24] shows resemblances to the Carfoniferous species, and its correct relationship cannot be ascertained until the hinge structure is known. All of the Pennsylvanian species which have been included in the genus *Moorea* should be removed, and either placed in a new genus or under the genus *Youngiella* Jones and Kirby. In this paper these Pennsylvanian species are tentatively referred to the genus *Youngiella.*

---

[24] Jones, Quart. Jour. Geol. Soc. London, vol. 46, pl. 20, figs. 9, 10, 1890. (Onondago chert, N. Y.)

Genus YOUNGIELLA Jones and Kirkby, 1895

Youngiella Jones and Kirkby, 1895, Ann. Mag. Nat. Hist., ser. 6, vol. 16, pl. 21, figs. 5a-d. —Ulrich and Bassler, 1923, Maryland Geol. Survey, Silurian, p. 315, Fig. ? 22, 1, 2. (Reproduction of original figures of genotype.)

Youngiella ? elongata Coryell and Sample Plate 4, fig. 14

Moorea elongata Coryell and Sample, 1932, Am. Mid. Nat., vol. 13, p. 258, pl. 24, fig. 19. (East Mountain shale, Mineral Wells, Texas.)

Carapace small, subquadrate in lateral view; length slightly more than twice the height; dorsal margin straight; anterior and posterior margins rounded; greatest height anterior; slight forward swing; ventral margin concave; ends bordered by scroll-like ridge; surface smooth. Length, .52 mm.; height, .25 mm.

Plesiotype.—Indiana University Paleontological Collections No. 2009.

Deese formation, locality 80, eight miles northwest of Ardmore, Oklahoma. At locality 25 a single specimen similar to this species was found, but it was much shorter in proportion to its height and not well enough preserved to figure.

Youngiella ? convergens, n. sp. Plate 4, figs. 16a, b

Carapace small, subquadrate in lateral view, length less than twice the height; greatest thickness posterior; dorsal margin straight; anterior and posterior margins rounded; greatest height anterior, ventral margin straight, converging rapidly toward dorsal margin posteriorly; ends bordered by scroll-like ridge; distinct concavity immediately back of anterior ridge; surface smooth. Length, .44 mm.; height, .25 mm.

Holotype.—Indiana University Paleontological Collections No. 2010.

Deese formation, locality 80, eight miles northwest of Ardmore, Oklahoma.

Youngiella ? gracilis, n. sp. Plate 4, figs. 15a, b

Carapace small, subquadrate in lateral view; more elongate than *Y. ? elongata* (Coryell and Sample); dorsal and ventral margins straight; anterior and posterior ends evenly rounded; greatest height anterior; greatest thickness in posterior half; ends bordered by scroll-like ridge; surface smooth. Length, .46 mm.;

height, .21 mm.; thickness, .14 mm.

Holotype.—Indiana University Paleontological Collections No. 2008.

Deese formation, locality 80, about eight miles northwest of Ardmore, Oklahoma.

This species differs from *Y. ? elongata* (Coryell and Sample) in having a straight instead of concave ventral margin.

Genus MOORITES Coryell and Billings, 1932

Moorites Coryell and Billings, 1932, Am. Mid. Nat., vol. 13, No. 4, p. 182.

Moorites minutus (Warthin) Plate 5, figs. 1a, b

Glyptopleurina ? minuta Warthin, 1930, Okla. Geol. Surv. Bull. 53, p. 67, pl. 5, figs. 6a, b. (Holdenville formation, Sasakwa limestone, three miles east of Ada, Oklahoma.)

Moorites minutus Coryell and Billings, 1932, Am. Mid. Nat., vol. 13, p. 183, pl. 18, figs. 6. (Wayland shale, five miles east of Cisco, Texas.) —Coryell and Sample, 1932, Am. Mid. Nat., vol. 13, p. 256, pl. 24, fig. 18. (East Mountain shale, Mineral Wells, Texas.)

Carapace small, elongate, subquadrate in lateral view; hinge line and dorsal margin straight; greatest height anterior; greatest thickness slightly posterior of center; posterior and anterior margins rounded, forward swing pronounced; ventral margin concave in middle, free margins defined by rounded flange, valve surface ornamented by a folded inosculating costa; surface between costæ marked by rows of pits roughly parallel to the costæ. Length, .84 mm.; height, .41 mm.; thickness, .29 mm.

Plesiotype.—Indiana University Paleontological Collections No. 2007.

Deese formation, locality 80, about eight miles northwest of Ardmore, Oklahoma. Also locality 22, Hoxbar; localities 155, 161, lower Dornick Hills formation.

Family CYTHERIDÆ Baird, 1850

Carapace generally elongate-oval, reniform, or subquadrate in outline; hinge generally denticulated, the right valve with two teeth, one at each end of the hinge line, and the left with corresponding pits. The hinge margin of the left valve, between the sockets, may bear a crenulate ridge or bar, which fits into a shallow notched groove between the terminal teeth of the right valve, as in *Cytheropteron*, or the hinge margin of the right valve may bear a low, narrow, denticulate bar which connects the terminal teeth, the corresponding furrow then lies between the terminal sockets of the left valve, while above this furrow in the left valve of *Cytheridea* is a narrow bar attached at each end to the dorsal edge of the valve at a point just above the middle of the notched terminal sockets. The hinge structure may be more simple, as in *Monoceratina,* in which case a narrow bar in the left valve fits into a slight groove in the right valve. Alaeform lateral expansions are often developed, and a compressed caudal process, or anterior marginal rim may be present. Surface smooth, punctate, nodulose, striate, reticulate, or spinose.

Species included in the family Youngiellidae may really belong with the Cytheridae.

Genus MONOCERATINA Roth, 1928

Monoceratina Roth, 1928, Jour. Pal., vol. 2, p. 15. —Alexander, 1933, Jour. Pal., vol. 7, p. 202.

Genotype, *Monoceratina ventralis* Roth, 1928, op. cit.

The Ostracoda of this genus have carapaces with more or less subrhomboidal outline, a long straight hinge line, nearly equal valves, and a pronounced spine-like horn pointing backward from the postero-ventral portion of each valve.

Until recently associated with the Cytheridae, this genus offered a rather difficult problem of orientation. The conventional method assigned the more acute cardinal angle to the anterior, in which case the carapace would have a backward swing, the sulcus would lie posterior to the middle, and the marginal swelling would lie mainly in the postero-ventral region. If the swelling be considered a brood pouch, then the genus must have produced mainly by parthenogenesis, since all well preserved specimens show this swelling, and consequently should be females. The greatest thickness of the carapace lies immediately above the horn although the blunt end of the carapace lies at the opposite end. If the end bearing the marginal swelling be considered anterior, then one might suggest that the animal was somewhat crowded and used this long encircling concavity in which to fold the long antennae, antennulae, and other appendages. In this case the sulcus would lie in front of the middle, the greatest thickness of the carapace would be in the posterior half, and the carapace would have a forward rather than a backward swing. The horns if pointed forward must have impeded the animal greatly in moving about through the vegetation and debris of the bottom. Dr. C. I. Alexander[25] has evidence to support this last method of orientation. He has found specimens of *Monoceratina* from the Turonian of Germany in which the pore-canals could be observed. The canals are more numerous at the end which appears broadly rounded in lateral view, as is always the case with the anterior end of Recent ostracodes.

Specimens belonging to this genus are very abundant in the Dornick Hills formation. The seemingly endless variety of forms that are encountered can be resolved into three main types, in addition to which many odd variations are found. The three main types are described as *Monoceratina ventralis* Roth, *M. dornickhillica*, n. sp., and *M. huddlei*, n. sp. In addition three variations are figured (see Plate 1) but not described. One somewhat resembles *M. ardmorensis* Harlton. The multiplicity of forms might be explained by hybridization, due to the fact that three or four closely related species had overlapping ranges in this area.

Monoceratina ventralis Roth Plate 1*, figs. 12, 13a, b

Monoceratina ventrale Roth, 1928, op. cit., p. 16, figs. 1a-c. (Wapanucka limestone, southeastern Oklahoma.) —Harlton, 1933, Jour. Pal., vol. 7, p. 21, pl. 7, figs. 13a, b. (Johns Valley shale, southeastern Oklahoma.)

Carapace suboblong in lateral view; hinge line long, straight; greatest height at or slightly posterior to center; greatest thickness one-third length from posterior end; greatest length oblique, from high narrowly rounded posterior end to slightly below the median extremity of the more broadly rounded anterior end; sulcus slightly anterior to middle; a pronounced marginal ridge extends from the anterior cardinal angle, around the edge of the

---

*The plates for this paper were prepared before the true position of **Monoceratina** was known. Roth assigned the genus to the family Primitiidae.

[25] Personal communication.

valve and terminates in a horn-like spine about one-third the length from the posterior end; ridge most prominent near the middle of the ventral margin where it overhangs the ventral contact; greatest inflation of valves near the middle of the posterior half; surface punctate. Average measurements of two figured specimens: Length, .87 mm.; height, .46 mm.; thickness, .48 mm.

Plesiotypes.—Indiana University Paleontological Collections Nos. 2031, 2032.

Dornick Hills formation, localities 148 and 160, Otterville, and Jolliff limestones; the first about seven miles south of Ardmore, and the second about two miles northwest of Berwyn, Oklahoma.

This form compares favorably with *M. ventralis* except that the horns seem to point more backward than downward.

Monoceratina dornickhillica, n. sp. Plate 1, figs. 14a, b

Carapace subrhomboidal in lateral view; hinge line long, straight; posterior cardinal angle acute, anterior obtuse; greatest height and thickness about one-third the length from the posterior end; posterior end high, margin greatly convex, greatest posterior extension at cardinal angle; anterior margin straight to slightly convex, roughly paralleling posterior margin, rounding sharply antero-ventrally into the gently convex ventral margin; marginal ridge extending around anterior and ventral margins, ending in a rather long pointed spine; surface punctate. Length, .85 mm.; height, .48 mm.; thickness, .44 mm.

Holotype.—Indiana University Paleontological Collections No. 2033.

Dornick Hills formation, Jolliff limestone, locality 160, about two miles northwest of Berwyn, Oklahoma.

This species differs from other species of *Monoceratina* in having a sharp, nearly right angled, posterior cardinal angle. The horn is longer and sharper and nearer the posterior extremity. The hinge line appears broader and the channeling more distinct, but this may not be a specific character.

Monoceratina huddlei, n. sp. Plate 1, figs. 15, 19

Adult specimens of this species appear to be somewhat larger in size than those of *M. ventralis* and *M. dornickhillica*, n. sp., and the posterior end is much larger and higher in proportion to the anterior end than in those species. The posterior end is more broadly rounded, with the greatest convexity median. The axis of greatest length is nearly parallel to the hinge line. The posterior cardinal angle is distinct, but obtuse, whereas in *M. ventralis* it is very obtuse and indistinct, and in *M. dornickhillica* it is very sharp and nearly at a right angle. The marginal ridge is distinct, but not as pronounced ventrally and the horn is less well developed than in the other species. Surface smooth, but some evidence of puncta. Length, 1.02 mm.; height, .55 mm.

Holotype.—Indiana University Paleontological Collections No. 2034.

Lower Dornick Hills formation, locality 155, about four miles north and two miles west of Ardmore, Oklahoma.

Measurements on the small, figured specimen are as follows: Length, .69 mm.; height, .39 mm.

This species is named for Dr. John Huddle, Chapel Hill, North Carolina.

Monoceratina, n. sp. Plate 1, fig. 20

Carapace oblong-subquadrate in lateral view; hinge line long, straight; greatest height slightly posterior to center; greatest thickness in posterior half; greatest length median; anterior gently and evenly convex; ventral border very slightly convex, edge of valve concealed by ventral inflation of the valve; posterior margin probably similar to anterior; sulcus near the middle between inflated anterior and posterior halves; entire surface of posterior half drawn gradually outwards and downwards into an enormous spine; two rounded tubercles situated one behind the other in the anterior cardinal area; surface coarsely granulose. Length, .77 mm.; height, .47 mm.

Specimen.—Indiana University Paleontological Collections No. 1998.

Deese? formation, locality 80, .7 mile northwest of Deese School about eight miles northwest of Ardmore, Aklahoma.

This most extraordinary ostracode is represented in the author's collections only by broken valves. The specimen figured has a piece broken off near the posterior cardinal angle and another in the posterior-ventral region.

Family BAIRDIIDAE Sars, 1887

In this paper the following genera are included in the *Bairdindae*: *Bairdia, Bythocypris, Macrocypris, Healdiacypris,* n. gen., *Bairdiacypris,* n. gen., *Waylandella, Healdia, Seminolites,* and *Harltonella,* n. gen. Because of the close relationship of these genera, and the intermediate forms between them it seems unwise to separate part of them for the family *Healdiidae* Harlton. *Healdiacypris* seems intermediate betneew *Healdia* and *Bythocypris.* Likewise *Waylandella* and *Harltonella* seem related to both of those genera. *Bairdiacypris* in intermediate between *Bairdia* and *Bythocypris.* Species of *Seminolites* may be found which have typical *Healdian* spines. One such, *Seminolites healdoides,* n. sp., is described in this paper.

Genus BAIRDIA McCoy, 1844

Bairdia McCoy, 1844, Syn. Carb. Limestone Foss. Ireland, p. 165.

Bairda cf. citriformis Knight Plate 5, figs. 2a, b

Bairdia citriformis Knight, 1928, Jour. Pal., vol. 2, no. 4, p. 321, pl. 43, figs. 4a-c. (Pawnee limestone, St. Louis County, Missouri.)

Carapace citriform in lateral view; dorsal and ventral margins smoothly curved, without angulation or slopes; greatest length obliquely from low, nipple-like posterior beak to high, upcurved anterior end; greatest height and thickness central; overlap slight; surface smooth. Length, .98 mm.; height, .55 mm.; thickness, .45 mm.

Plesiotype.—Indiana University Paleontological Collections No. 2139.

Dornick Hills formation, Lester limestone member, locality 145, seven miles north of Ardmore, Oklahoma.

Bairdia dornickhillensis Harlton Plate 5, figs. 3a, b

Bairdia dornickhillensis Harlton, 1929, (*B. pottsvillensis* in explanation of pl. 2,), Am. Jour. Sci., ser. 5, vol. 18, p. 268, pl. 2, fig. 12. (Dornick Hills formation, Carter County, Oklahoma.)

Carapace large and thick, with subrhomboidal outline in lateral view; dorsal margin arched, dorso-anterior slope nearly straight, varying from slightly concave to slightly convex in different specimens; dorso-posterior slope curved outwardly near the middle; ventral margin straight, with slight tendency to be concave rather than convex; anterior broadly rounded; posterior acuminate. The two sides are nearly parallel, for a distance of one-half the length of the carapace, from about one-quarter of the distance from the posterior extremity to about one-quarter of the distance from the anterior extremity, the greatest thickness being about one-third of the way from the posterior. Valves unequal, left valve overlapping the right completely; overlap strongest on the dorsal and ventral margins, becoming very weak along the upper anterior margin. Length, 1.32 mm.; height, .75 mm.; thickness, .53 mm.

Plesiotype.—Indiana University Paleontological Collections No. 2145.

Lower Deese, locality 69, seven miles south and one mile east of Ardmore, Oklahoma; also at locality 74, about eight miles northwest of Ardmore, and locality 126, 3½ miles south of Ardmore.

Bairdia punctata, n. sp. Plate 5, figs. 7a, b

Carapace large, punctate, subtriangular, centrally obese, greatest height anterior of center; dorsal margin arched, dorso-anterior slope short and straight, with a slight tendency to be convex; dorso-posterior slope long, straight, and steep, with a small concave area near the beak; posterior end acuminate; ventral border nearly straight; anterior end broadly rounded. Valves unequal, left valve overlaps right all around, although narrowly at anterior end; overlap strongest on dorsal and ventral margins. The shell is delicate, and rarely free from distortion or crushing, the ventral border being most commonly affected. Length, 1.39 mm.; height, .9 mm.; thickness, .63 mm.

Holotype.—Indiana University Paleontological Collections No. 2144.

Deese formation, locality 69, Devils Kitchen member, about seven miles south and one mile east of Ardmore, Oklahoma. This species occurs also in the Upper Deese, locality 79, eight miles northwest of Ardmore.

Bairdia biacuta, n. sp. Plate 5, figs. 5a, b

Carapace small for the genus, elongate, biacute; greatest height anterior to center; canoe shaped in dorsal view, greatest thickness central; dorsal margin long, flatly convex, dorso-anterior and dorso-posterior slopes low, becoming concave near extremities; posterior end bluntly pointed; anterior extremity high, more pointed than posterior and upturned; ventral margin convex; antero-ventral slope conspicuous, rounding upward to the high anterior extremity; overlap weak, inconspicuous. Length, .76 mm.; height, .3 mm.; thickness, .23 mm.

Holotype.—Indiana University Paleontological Collections No. 2141.

Dornick Hills formation, Lester limestone, locality 145, seven miles north of Ardmore, Oklahoma.

This species is recognized by its elongate biacute form, and high, upturned, pointed anterior end.

Bairdia crassa Harlton Plate 5, figs. 8a, b

Bairdia crassa Harlton, 1929, Univ. of Texas, Bull. 2901, p. 158, pl. 4, figs. 3a, b, c. (Canyon, Menard County, Texas.)

Carapace small for the genus; subrhomboidal in lateral view; highly inflated, especially in the dorso-posterior third; greatest height central; dorsal margin rather highly arched; posterior-dorsal slope concave near the low, acuminate posterior beak; antero-dorsal slope slightly concave; ventral border nearly straight near the middle, rising slightly to the posterior beak, and turning sharply in almost a straight line toward the high, sharply rounded anterior end; overlap small, greatest on the antero-dorsal slope and near the center of the ventral margin. Length, 1.01 mm.; height, .58 mm.; thickness, .54 mm.

Plesiotype.—Indiana University Paleontological Collections No. 2134.

Deese formation, locality 79, eight miles northwest of Ardmore, Oklahoma. Also at localities 64, 68, 85, and possibly 144 (Pumpkin Creek). The forms in the last locality are very close if not the same species.

The distinguishing feature of this form is the extremely high dorso-posterior inflation, the right valve rising high enough to obscure the line of commissure and often the dorsal edge of the left valve when viewed from the right side. The specimen figured by Warthin (1930, Okla. Geol. Surv., Bull. 53, pl. 6, figs. 1a, b) is closely related, but is longer, and different in lateral view, especially at the posterior end. See discussion under *B. blakei*. *B. summa* Coryell and Billings (Wayland Shale, Texas) is another closely related form.

Bairdia bidorsalis, n. sp. Plate 5, figs. 6a, b

Carapace subrhomboidal in lateral view; strongly inflated, especially in dorsal and dorso-posterior regions, causing dorsum to appear as two ridges with a furrow between; greatest height just anterior to center; dorsal margin highly arched; dorso-posterior slope long, steep, with outward bend near the middle, concave near the upturned, bluntly acuminate posterior beak; antero-dorsal slope short, steep, straight; ventral margin nearly straight, rounding up smoothly to anterior and posterior ends; anterior end high; overlap moderately strong on dorsal, antero-dorsal, and ventral margins. Length, 1.1 mm.; height, .6555 mm.; thickness, .58 mm.

Plesiotype.—Indiana University Paleontological Collections No. 2146.

Deese formation, Devils Kitchen member, locality 68, seven miles south and one mile east of Ardmore, Oklahoma.

This species is very closely related to *B. crassa*. It is more restricted stratigraphically, however. It is more obese, larger, the antero-ventral slope is more rounded, and the anterior extremity not so narrowly rounded as in *B. crassa;* the beak is not so narrow, and the right valve does not bulge upward as high, although the form is wider in the dorsal and posterior-dorsal regions.

Bairdia glennensis Harlton Plate 5, figs. 12a, b

Bairdia glennensis Harlton, 1927, Jour. Pal., vol. 1, p. 210, pl. 33, fig. 10

Carapace large, elongate, suboblong in lateral view, canoe shaped in dorsal view, not quite two and one-half times as long as high; greatest height and thickness posterior to center; dorsal margin flat, gently convex, antero-dorsal slope not differentiated; postero-dorsal slope distinct, straight, bordering about one-third the length of the shell; posterior end narrowly rounded; anterior end broadly rounded; ventral border long, concave near middle, overlap narrow, about equal on dorsal and ventral margins, passing out near each end; surface smoothly convex. Length, 1.58 mm.; height, .655 mm.; thickness, .46 mm.

Plesiotype.—Indiana University Paleontological Collections No. 2143.

Deese formation, Devils Kitchen member, locality 69, seven miles south and one mile east of Ardmore, Oklahoma.

This form most closely resembles *B. warthini*, and is recognized by its elongate form and concavity of ventral margin.

Bairdia whitesidei, n. sp. Plate 5, figs. 10a, b

Bairdia beedei Warthin (not Ulrich and Bassler), 1930, Okla., Geol. Surv., Bull. 53, p. 69, pl. 5, figs. 9a, b. (Holdenville formation.)

Carapace large, centrally obese, subrhomboidal to subovate in lateral view; fusiform in dorsal view; dorsal margin highly arched; antero-dorsal slope slightly concave; postero-dorsal slope steep, bent outward slightly near the middle; beak bluntly pointed, upturned; ventral margin convex, rather sharply near the middle; anterior end broadly rounded, extremity near the median line; greatest height and thickness near the middle; overlap very wide, and edges of left valve thick on dorsal and ventral margins, greatest width near center of ventral margin; dorsal commissure line angulated at three places, with greatest height anterior to center; ventral commissure line turning sharply downward anterior to center, terminating rather sharply the wide overlap. Length, 1.68 mm.; height, .975 mm.; thickness, .73 mm.

Holotype.—Indiana University Paleontological Collections No. 2133.

Deese formation, locality 95, about eight miles northwest of Ardmore, Oklahoma. Also locality 69, Devils Kitchen member of Deese, seven miles south, and one mile east of Ardmore.

This form is distinguished from *B. beedei* Ulrich and Bassler by the great central obesity, difference in the dorsal and ventral lines of commissure and greater overlap, especially on the ventral margin. It differs slightly from *B. beedei* Warthin on the dorsal commissure line and in the greater central obesity.

This species is named in honor of Mr. Robert M. Whiteside, Tulsa, Oklahoma.

Bairdia warthini, n. sp. Plate 5, figs. 11a, b

Bairdia haworthi Warthin (not Knight), 1930, Okla. Geol. Surv., Bull. 53, p. 72, pl. 6, figs. 4a. b. (Holdenville, Wewoka, east-central Oklahoma.)

Carapace elongate subovate in lateral view; greatest height near center; greatest thickness posterior to center, posterior end noticeably thicker and more rounded than anterior end in dorsal view; dorsal margin, anterior-dorsal slope, and postero-dorsal slope one continuous gently convex line, tending to straighten at the anterior end and steepen as it merges smoothly into the bluntly rounded posterior end; anterior end slightly above median line, and broadly rounded for the height of the shell; ventral margin long, concave near central third, concavity greatest just anterior to center; overlap moderately strong on dorsal margin, dying out abruptly with sharp curve in line of commissure near anterior and posterior ends; overlap strongest on ventral margin, especially at the strongest point of concavity, dying out abruptly from there or continuing very narrowly from there to the anterior end where it disappears entirely; posteriorly the overlap dies out gradually, so that it cannot be observed in most specimens on the anterior and posterior extremities. When such overlap is observed it is mostly due to slight crushing. Length, 1.07 mm.; height, .41 mm.; thickness, .34 mm.

Holotype.—Indiana University Paleontological Collections No. 2001.

Deese formation, localities 68, 85, 95, 98 (holotype), and Dornick Hills, locality 150.

The forms from locality 85 are more robust than those from other horizons, an angle is quite apparent on the postero-dorsal slope instead of the gently convex margin, and a slight overlap is apparent on most specimens on the posterior end. The forms from this horizon should perhaps be given varietal distinction. This is apparently a Deese species mainly, being abundant there. No specimens have been identified with this from the Hoxbar. Coryell and Billings have described one closely related species from the Wayland shale of Texas (Am. Mid. Nat., 1932, vol. 13, p. 173, pl. 17, fig. 5). This form shows overlap all around; the ventral overlap is in the middle and symmetrical. It is more pointed posteriorly, and postero-ventral slope is longer.

Bairdia bicornis, n. sp. Plate 6, figs. 3a, b

Carapace large, subrhomboidal in lateral view, extremely obese and ventricose; dorsal margin high, truncate, turning abruptly downward to both dorso-anterior, and dorso-posterior slopes, the highest point of the dorsal margin being at the top of the concave antero-dorsal slope; postero-dorsal slope very steep, lower part concave; posterior beak acuminate, upturned; ventral margin nearly straight, rounding upward with a convexly smooth curve to posterior end, and turning rather sharply upward to the high narrowly rounded anterior end. Each valve bears a thin, ear-like horn or tubercle at the junction of the antero-dorsal slope and anterior margin; a second pair of very thin tubercles or beads may occur directly below these two. Overlap moderately strong on dorsal margin, antero-dorsal slope, and central part of ventral margin; overlap practically nil on antero-ventral and postero-ventral slopes. Length, 1.53 mm.; height, .93 mm.; thickness, .77 mm.

Holotype.—Indiana University Paleontological Collections No. 2025.

Hoxbar formation, locality 13, Union Dairy (Crinerville?) member, R. R. cut northwest of cemetery at south edge of Ardmore, Oklahoma.

Bairdia blakei Harlton Plate 6, figs. 1a, b, 2

Bairdia nitida Harlton, 1928, Jour. Pal., vol. 2, p. 39, pl. 21, fig. 12. (Hoxbar formation, Love County, Oklahoma.) —Harlton, 1929, Univ. of Texas, Bull. 2901, p. 155, pl. 3, figs. 3a, b. (Canyon Menard County, Texas.) *B. blakei* Harlton, 1931, Jour. Pal., vol. 5, 6. 163.

Carapace small, subrhomboidal in lateral view; inflated, noticeably so in dorso-posterior region; however, right valve does not overhang and obscure the line of commissure; greatest thickness slightly posterior of center; dorsal border roundly arched, antero-dorsal slope straight to slightly concave, dorso-posterior slope steep; bluntly acuminate posteriorly; ventral border straight, or gently convex, rounding up smoothly to posterior and anterior ends; overlap very wide on dorsal border, dorsal edge of left valve thick, ventrally the widest overlap is near the center. Length, .95 mm.; height, .62 mm.; thickness, .46 mm.

Plesiotype.—Indiana University Paleontological Collections No. 2003.

Hoxbar formation, localities 8, 13, and 20, and Deese formation, locality 95.

B. blakei is closely related to *B. crassa* Harlton, and there are many variants of these two. The specimen figured by Warthin (1930, Okla. Geol. Surv., Bull., 53, pl. 6, fig. 3) is closely related to both of these forms, but the writer does not believe it should be identified specifically with either one of them. The form figured by Delo (1930, Jour. Pal., vol. 4, pl. 12, fig. 15) seems to be more or less intermediate between the two.

Bairdia menardensis Harlton ? Plate 6, figs. 4, 5

Bairdia menardensis Harlton, 1929, Univ. of Texas, Bull. 2901, p. 158, pl. 4, figs. 1a, d. (Canyon, Menard County, Texas) —Warthin, 1930, Okla. Geol. Surv., Bull. 53, p. 71. (Several poorly preserved specimens from the Holdenville and Wewoka formations doubtfully referred to this species.) —Delo, 1930, Jour. Pal. vol. 4, p. 164, pl. 12, fig. 16. (Upper Carboniferous, Western Texas, C. Cromwell, Winslow No. 1, depth 775 feet.)

At various horizons in the Hoxbar numerous single valves have been found which may be identified with this form. However, length-width ratio variations are considerable, and it is possible that more than one species is represented by these similar single valves.

Bairdia oklahomaensis Harlton Plate 5, figs. 9a, b

Bairdia oklahomaensis Harlton, 1927, Jour. Pal., vol. 1, p. 209, pl. 33, fig. 7. (Upper Glenn, Middle Deese?, Ardmore Basin, Oklahoma.) —Harlton, 1929, Univ. of Texas, Bull. 2901, p. 156, pl. 3, fig. 5a. (Canyon, Menard County, Texas.) —Warthin, 1930, Okla. Geol. Surv., Bull. 53, p. 69, pl. 5, figs. 8a, b. (Holdenville and Upper Wewoka, central-eastern Oklahoma.) —Coryell and Sample, 1932, Amer. Mid. Nat., vol. 13, p. 264, pl. 25, fig. 9. (East Mountain shale, Mineral Wells formation, Texas.)

Carapace large, subrhomboidal in lateral view, greatest height slightly anterior to center, elongate hexagonal in dorsal view, greatest thickness between center and posterior third; dorsal margin highly arched; antero-dorsal slope gently convex; postero-dorsal slope steep with slight outward bend near the middle; posterior acuminate; ventral border nearly straight, except where it slopes up the posterior and anterior extremities; anterior end broadly rounded but more sharply convex where anterior margin and antero-dorsal slope meet; overlaps strongest on antero-dorsal slope and ventral margin. Length, 1.3 mm.; height, .79 mm.; thickness, .56 mm.

Plesiotype.—Indiana University Paleontological Collections No. 2136.

Hoxbar formation, locality 25, 175 feet above the Confederate limestone, one and three-quarters miles south of Ardmore, Oklahoma. The distinguishing character of this form is that the highest point of the commissure* is posterior to the highest point on the dorsal margin. In *Bairdia auricula* Knight this point lies anterior to the highest point on the dorsal margin. For this reason the writer does not consider these two forms the same.

Bairdia hoxbarensis Harlton **Plate 6, fig. 8**

Bairdia hoxbarensis Harlton, 1927, Jour. Pal., vol. 1, p. 211, pl. 33, fig. 12. (Upper Glenn, Ardmore Basin, Oklahoma.) —Harlton, 1929, Univ. of Texas, Bull. 2901, p. 154, pl. 3, fig. 1. (Canyon, Menard County, Texas.)

Bairdia altifrons Knight, 1928, Jour. Pal., vol. 2, p. 324, pl. 43, figs. 3a, b. (Fort Scott limestone, St. Louis County, Missouri.)

Carapace elongate sub-oblong; length a little more than twice the height; dorsal border gently convex; antero-dorsal slope merely a continuation of dorsal margin to where it meets the broadly rounded anterior margin; postero-dorsal slope breaking sharply downward at about one-half the distance toward the moderately pointed posterior beak; ventral border concave; overlap slight, greatest on the dorsal margin, and near the middle of the ventral margin; shell noticeably inflated throughout. Length, 1.27 mm.; height, .58 mm.

Plesioytpe.—Indiana University Paleontological Collections No. 2017.

Hoxbar formation, locality 13, Union Dairy (Crinerville?) member, south edge of Ardmore; also locality 53,, shale 200 feet above the Upper Westheimer, five miles south, and a mile and a half east of Ardmore.

---

*This term is used as with other bivalved forms to designate the line of junction of the two valves as seen from the outside.

Bairdia pompilioides Harlton Plate 6, figs. 15a, b

Bairdia pompilioides Harlton, 1928, Jour. Pal., vol. 2, p. 140, pl. 21, fig. 13. (Upper Glenn (Hoxbar), Ardmore Basin, Oklahoma.) —Harlton, 1929, Univ. of Texas, Bull. 2901, p. 154, pl. 2, fig. 7, pl. 3, fig. 8. (Canyon, Menard County, Texas.) —Warthin, 1930, Okla. Geol. Surv., Bull. 53, p. 70, pl. 5, figs. 11a, b. (Upper Holdenville.)

B. subcitriformis Knight, 1928, Jour. Pal., vol. 2. p. 322, pl. 43, figs. 5a, b. (Pawnee limestone, Clayton, St. Louis County, Missouri.)

Carapace very large, subfusiform; length twice the height; greatest height and thickness in central third; dorsal margin broadly arched; antero-dorsal and postero-dorsal slopes both concave, the latter markedly so; posterior beak long, prominent, and upturned; anterior end bluntly pointed, beak-like, and turned slightly upward; ventral border nearly straight along the central third of the shell, with a slight tendency to be concave; overlap broad on dorsal margin, narrowing gradually toward each end; very weak on entire ventral border except near the middle where it is moderately strong. Length, 1.93 mm.; height, .95 mm.; thickness, .72 mm.

Plesiotype.—Indiana University Paleontological Collections No. 2059.

Hoxbar formation, Union Dairy (Crinerville?) limestone, locality 13, R. R. cut northwest of cemetery, south edge of Ardmore, Oklahoma. Also, Confederate limestone two miles south of Ardmore.

Specimens from the upper Holdenville, if an average specimen was figured by Warthin, appear to be somewhat smaller than specimens from the Ardmore Basin and Menard County, Texas, the length-height ratio being the same, however. Harlton measured specimens from 1.4 mm. to 1.96 mm. in length. These check with the writer's observations. *B. subcitriformis* Knight agrees well in size, the height being somewhat greater in proportion to the length; the ventral margin being more convex. These two forms may not be the same, although they are surely closely related.

Bairdia hispida, var. alta, n. var. Plate 6, figs. 6a, b

Carapace subrhomboidal in lateral view, thick, elongate ovoid in dorsal view; greatest height and thickness central; dorsal border roundly arched; antero-dorsal slope straight; postero-dorsal slope steep, upper half convex, lower half concave near the beak; beak bluntly acuminate to sharply rounded; ventral margin convex; anterior extremity near median line, and rather narrowly rounded; overlap very wide and edges of left valve thick on dorsal margin, antero-dorsal slope and ventral margin. Length, 1.4 mm.; height, .9 mm.; thickness, .68 mm.

Holotype.—Indiana University Paleontological Collections No. 2135.

Hoxbar formation, locality 9, Crinerville member, Pleasant Hill Syncline, northwest side of Criner Hills, four miles south and two and one-half miles west of Ardmore, Oklahoma.

This form is distinguished by the thick overlap, generally stout, rugged character of the shell, the very straight and almost horizontal line of the commisure at the dorsal border, with highest point well anterior to center, and general appearance of leaning backward. The specimen figured agrees quite well with Harlton's figure 2b (Univ. of Texas, Bull. 2901, p. 155, pl. 3.) It does not agree so well with the holotype of *B. hispida* Harlton. The holotype is either a poor specimen of the species, or a restudy will show that the two specimens (2a, 2b) are not the same species, and the specimens figured in 2b, and by Delo (Jour. Pal., vol. 4, pl. 12, fig. 14), will have to be renamed.

Bairdia hispida, var. lesterica, n. var. Plate 5, figs. 4a, b

This form differs from *B. hispida* and *B. hispida*, var. *alta*, by the narrower overlap, shorter horizontal portion of the dorsal commissure line, higher anterior extremity, greatest height being definitely posterior to center, greater central thickness and convexity of the valve surfaces. Length, 1.17 mm.; height, .77 mm.; thickness, .64 mm.

Holotype.—Indiana University, Paleontological Collections No. 2147.

Dornick Hills formation, Lester limestone, locality 145, seven miles north of Ardmore, Oklahoma.

Bairdia longirostris, n. sp. Plate 6, figs. 11a, b

Carapace, subrhomboidal in lateral view; elongate hexagonal in dorsal view, sides straight, ends thin; highest near center; length twice height; dorsal margin flat; antero-dorsal slope short, concave; postero-dorsal slope rather steep, straight, turning outward abruptly near posterior extremity; beak long, thin, bluntly rounded; ventral margin nearly straight, slightly convex; anterior extremity slightly above median line, broadly rounded; overlap very wide on dorsal margin and antero-dorsal slope, very narrow elsewhere; line of commissure at the dorsal margin straight and nearly horizontal for about two-fifths the length of the shell, rising anteriorly slightly, the highest point of the commissure being well anterior to center. Length, 1.27 mm.; height, .64 mm.; thickness, .4 mm.

Holotype.—Indiana University Paleontological Collections No. 2142.

Hoxbar formation, Daube limestone, locality 5, six miles south and three miles east of Ardmore, Oklahoma. Also at locality 7, and possibly at 85, although this identification is based on a single valve.

Bairdia amygdaliformis, n. sp. Plate 6, figs. 12a, b

Carapace almond-shaped in lateral view, elongate oval-shaped in dorsal view; greatest height anterior to center; greatest thickness central; dorsal margin, dorso-posterior slope, and dorso-anterior slope merged together in one smooth, gently convex curve; posterior end narrowly rounded, not acuminate; anterior end broadly rounded, semicircular in outline, merging smoothly into the straight ventral margin. Length, 1.46 mm.; height, .81 mm.; thickness, .58 mm.

Holotype.—Indiana University Paleontological Collections No. 2029.

Hoxbar formation, Union Dairy (Crinerville?) limestone, locality 13, R. R. cut, south edge of Ardmore.

Bairdia auricula Knight Plate 6, figs. 13a, b

Bairdia auricula Knight, 1928, Jour. Pal., vol. 2, p. 319, pl. 43, fig. 3. (Ft. Scott limestone, St. Louis County, Missouri.)

Carapace large, subovate in lateral view; elongate hexagonal in dorsal view with the two sides inconspicuous; dorsal margin highly, but symmetrically, arched; antero-dorsal slope slightly concave; postero-dorsal slope steep, bending outward slightly near the middle, and slightly concave near the acuminate, slightly upturned beak; ventral margin slightly convex, nearly straight from about one-third the length from the anterior end to about one-fifth of the length from the posterior end; anterior end broadly rounded, the extremity definitely below the dorso-anterior angle and near the median line; greatest height central; greatest thickness slightly anterior to the center; overlap strongest on the dorsal border, antero-dorsal slope, and at the middle of the ventral margin; highest point on the line of commissure definitely anterior to the highest point on the dorsal margin. Length, 1.64 mm.; height, .99 mm.; thickness, .68 mm.

Plesiotype.—Indiana University Paleontological Collections No. 2057.

Hoxbar formation, Union Dairy limestone, locality 13, railroad cut at south edge of Ardmore, Oklahoma.

This form differs from *B. oklahomaensis* Harlton in having the highest point on the line of commissure anterior rather than posterior to the middle of the carapace. Thickness apparently is no criterion. *B. auricula* may also show differences in outline in the dorsal view, and in the position of greatest thickness. The position of greatest thickness is definitely in the posterior half in *B. oklahomaensis,* while it may not be in *B. auricula.* This cannot be determined from Knight's description or figures.

Bairdia lunata, n. sp. Plate 6, fig. 10

Carapace elongate, crescent-shaped in lateral view; greatest height and thickness slightly posterior to middle; dorsal margin highly arched; ventral margin concave; posterior end only slightly more narrowly rounded than anterior; overlap greatest on dorsal and ventral margins; surface smooth. Length, 1.22 mm.; height, .54 mm.

Holotype.—Indiana University Paleontological Collections No. 2137.

Hoxbar formation, locality 22, two and one-half miles south of Ardmore, Oklahoma.

This form somewhat resembles the new genus *Bairdiacypris* However, because of the more slender posterior end and the typical Bairdian overlap it is placed in that genus for the present.

Its relations to forms like *Bairdiacypris deloi* are evident.

Bairdia ignota, n. sp. Plate 6, fig. 14

Carapace small, subovate to subrhomboidal; greatest height anterior; greatest thickness central; dorsal margin composed of long, nearly straight posterior dorsal slope joined by sharp, rounded angle to short, steep antero-dorsal slope; anterior end high, rather sharply rounded; posterior end low, sharply rounded; overlap greatest on dorsal and ventral margins; surface smooth. Length, .8 mm.; height, .46 mm.

Holotype.—Indiana University Paleontological Collections No. 2138.

Deese formation, locality 66, Arnold limestone, about nine miles northwest of Ardmore, Oklahoma.

Bairdia ciscoensis Harlton ? Plate 7, figs. 1-6

Bairdia ciscoensis Harlton, 1927, Jour. Pal., vol. 1, p. 210, pl. 33, fig. 8. (Cisco of Texas.)

Bairdia ciscoensis Coryell and Sample, 1932, Am. Mid. Nat., vol. 13, p. 265, pl. 25, fig. 8. (Mineral Wells, Mineral Wells shale pit, Mineral Wells, Texas.)

Carapace subquadrate in lateral view; dorsal margin highly arched, antero-dorsal slope straight or slightly concave; postero-dorsal slope steep, bending outward near the middle, slightly concave near the low beak; ventral margin straight to slightly convex, depending on the age of the individual, angulation and straight lines more pronounced in adult specimens; anterior extremity high at dorso-anterior angle, sharply rounded; greatest height and thickness central; overlap strong on dorsal border, and strongest on ventral border slightly anterior to middle; highest point on the line of commissure anterior to center. Length (Fig. 1), (adult), 1.56 mm.; height, .975 mm.; thickness, .68 mm.

Plesiotype.—Indiana University Paleontological Collections No. 2024.

Hoxbar formation, Union Dairy limestone, locality 13, south edge of Ardmore, Oklahoma.

This form is closely related to *B. auricula* Knight. The chief difference is in the anterior end, *B. auricula* being broadly rounded with the extremity slightly below the dorso-anterior angle, while in this case the anterior extremity is high, coincident with the dorso-anterior angle, and narrowly rounded. The anterior ventral slope is straight to slightly convex.

Many immature specimens of *Bairdia* were found at this locality, and therefore offered an unusual opportunity for an ontogenetic study. Specimens which appeared to belong to this species were selected and arranged according to size. It may be noted that the length increases slightly in proportion to the height with younger individuals; that the dorsal margin becomes less highly arched; and that the angular outline in lateral view and the angles of the commissure line are replaced by curves. Number 4 differs in having a dorso-posterior inflation not characteristic of the species and may not belong here. Number 5 differs at the anterior extremtiy, but it seems to be much too narrow there to be considered as a young individual of *B. auricula,* the only other closely related *Bairdia* found at that locality.

Bairdia ardmorensis Harlton

Bairdia ardmorensis Harlton, 1929, Am. Jour. Sci., vol. 18, p. 267, pl. 2, fig. 11. (Dornick Hills formation, Carter County, Oklahoma.) — 1933, Jour. Pal., vol. 7, p. 25, pl. 7, fig. 8. (Johns Valley shale, southeastern Oklahoma.)

Carapace large, subrhomboidal in lateral view; length about twice the height; greatest height and thickness near the middle; dorsal margin rather highly arched; anterior extremity rather narrowly rounded; posterior extremity acuminate; ventral margin gently convex; ovelap rather wide dorsally and at the middle of the ventral border; surface smooth or granulose, depending upon the preservation.

This species occurs throughout the Dornick Hills, but appears to be more common below the Otterville limestone.

Bairdia cf. ardmorensis Harlton Plate 7, figs. 7a, b

Characteristic figures of the typical *B. ardmorensis* may be seen in the references given above. Associated with that species were numerous specimens of a somewhat smaller size. These might well be taken for a distinct species if it were not for the fact that an occasional specimen seems more or less intermediate between the two. Comparison shows that the large and small individuals possess several important features in common. The smaller forms, one of which is figured, are more elongate, more obliquely rhomboidal, and more truncate antero-ventrally. The middle portion of the dorsal commissure line, which is nearly parallel to the ventral margin in *B. ardmorensis,* is long, and similarly located on the smaller forms, but is quite oblique, and converges posteriorly toward the ventral margin. A rounding out of the antero-ventral slope, and of the posterior half of the ventral margin, would make these forms very similar to the typical *B. ardmorensis.* Measurements of the figured specimen are as follows: length, .75 mm.; height, .39 mm.; thickness, .29 mm.

Plesiotype.—Indiana University Paleontological Collections No. 2162.

Dornick Hills formation, locality 163, about two miles northwest of Berwyn, Oklahoma.

Genus BAIRDIACYPRIS, n. gen.

Genotype, *Bairdiacypris deloi,* n. sp.

Carapace elongate, robust, subreniform in lateral view; greatest length well below median; greatest height and thickness in posterior half; dorsal margin long, straight or slightly convex; antero-dorsal and postero-dorsal slopes straight, short; ventral margin concave; posterior end low, narrowly rounded; anterior extremity slightly below median, more broadly rounded than posterior; left valve larger, overlap narrow but even; surface smooth.

This genus shows relationships to both *Bairdia* and *Bythocypris.* The size is nearly twice that of the average *Bythocypris,* approaching that of the average *Bairdia.* The overlap is too even for *Bairdia* and in general too narrow. The dorsal overlap is extremely small on some specimens.

This genus somewhat resembles the species placed in *Argilloecia* Sars by Delo. Delo's species should probably be placed in the synonymy of *Bairdiacypris,* since it most likely is not congeneric with *Argilloecia* Sars. The latter is supposedly an equivalved form.

Bairdiacypris deloi, n. sp. Plate 7, figs. 8a, b, 9a, b

Carapace elongate, very robust, subreniform in lateral view; greatest length well below the median; greatest height and thickness in the posterior half; dorsal margin long and straight in some specimens, more convex in others; antero-dorsal and postero-dorsal slopes straight or slightly convex; posterior end low, narrowly rounded pointing slightly downward; anterior end more sharply rounded near the median line, or slightly below; ventral margin concave; left valve largest, overlap narrow, but even; surface smooth. Length, 1.32 mm.; height, .54 mm.; thickness, .45 mm.

Holotype.—Indiana University Paleontological Collections No. 2018. (figures 8a, b.)

The specimen figured on Plate 7, figure 9, had the following measurements: Length, 1.37 mm.; height, .62 mm.; thickness, .54 mm.

Paratype.—Indiana University Paleontological Collections No. 2054.

Hoxbar formation, Union Dairy limestone member, locality 13, south edge of Ardmore, Oklahoma.

The second figured specimen is more robust, and otherwise larger than the holotype. The dorsal overlap also seems to be stronger than on other specimens. Another specimen which has been tentatively referred to this species is still more elongate and more concave ventrally.

Genus BYTHOCYPRIS Brady, 1880

Bythocypris Brady, 1880, Rep. Voy. Challenger, Zool., vol. 1. p. 45, pl. 5, fig. 1.

The part of Brady's original description which applies to the carapace is briefly: reniform or subreniform in outline, left valve much larger than the right, overlapping on dorsal and ventral margins. Distinguished from *Cypris* by the unequal valves. The main distinction from *Bairdia* is in the soft parts, but the shapes of the carapaces are also different.

Bythocypris tomlinsoni Harlton Plate 7, figs. 11a, b

Bythocypris tomlinsoni Harlton, 1929, Am. Jour. Sci., vol. 18, 5th ser., p. 270, pl. 2, figs. 17a-d. (Dornick Hills formation, Carter County, Oklahoma.) —Harlton, 1933, Jour. Pal., vol. 7, No. 1, p. 25, pl. 7, fig. 9. (Johns Valley shale, southeastern Oklahoma.)

Carapace with flattened semicircular outline in lateral view; greatest height slightly posterior to center; greatest thickness in posterior half; dorsal border lowly arched, sloping down with gentle convexity to the low, rounded anterior end; ventral margin straight; posterior end steeply rounding or rounded, truncated postero-ventrally; left valve larger, overlapping right all around; surface smooth. Length, .76 mm.; height, .43 mm.; thickness, .3 mm.

Plesiotype.—Indiana University Paleontological Collections No. 2088.

Dornick Hills formations, shale about half way between Lester and Otterville limestones, locality 152, about four miles northwest of Ardmore, Oklahoma.

This species occurs throughout the Dornick Hills formation, but has not been observed higher. The form identified as *B. tomlinsoni* by Coryell and Billings, from the Wayland shale of Texas, greatly resembles this species. However, their form is only about half the size of an average adult *B. tomlinsoni.* This difference, coupled with the great stratigraphic discrepancy, I consider sufficient to exclude it for the present.

Bythocypris parallela Knight Plate 8, figs. 4a, b

Bythocypris parallela Knight, 1928, Jour. Pal., vol. 2, p. 327, pl. 44, figs. 2a, b. (Upper Fort Scott limestone, St. Louis County, Missouri.) — Coryell and Sample, 1932, Am. Mid. Nat., vol. 13, No. 5, p. 266, pl. 25, fig. 11. (East Mountain shale, Mineral Wells, Texas.)

Carapace, small, elongate, length slightly more than twice the height; dorsal margin long, lowly convex at center for nearly half the length of the shell, increasing rapidly toward ends; anterior end high, well rounded; ventral margin straight or slightly concave; posterior end gently convex down to the extremity which is sharply angled due to postero-ventral truncation; overlap even all around; surface smooth. Length, .58 mm.; height, .28 mm.; thickness, .21 mm.

Plesiotype.—Indiana University Paleontological Collections No. 2087.

Hoxbar formation, locality 53, shale above Westheimer, six miles south and two and one-half miles east of Ardmore, Oklahoma.

Bythocypris deesensis, n. sp. Plate 7, figs. 12a, b

Carapace small, subovate in lateral view; length 1.77 times height; dorsal margin convex, a semi-circular arch embracing both ends; anterior end rather sharply convex where curve of the dorsal margin meets the upturned anterior portion of ventral border; ventral border convex, except for concave portion about one-third the distance from anterior end; posterior end truncated postero-ventrally; overlap greatest at middle of ventral border, just behind the concave area; greatest height slightly posterior to center; greatest length below center; greatest thickness in posterior half; surface smooth. Length, .62 mm.; height, .35 mm.; thickness, .235 mm.

Holotype.—Indiana University Paleontological Collections No. 2094.

Deese formation, locality 98, about eight miles northwest of Ardmore, Oklahoma.

Differentiated from the closely related *B. simillima,* n. sp., and *B. hoxbarana,* n. sp., by outline and convexity of the valves.

Bythocypris simillima, n. sp. Plate 7, figs. 15a, b

Carapace small, pediform, elongate; length a little more than twice the height; greatest height and thickness central; dorsal margin evenly convex; anterior end broadly rounded, extremity about at the median line; ventral border about straight at the middle for a distance of about half the length of the carapace, very slightly concave just anterior to center and decidedly convex where margin makes the upward and outward swing to the sharp posterior-ventral angle; posterior border curves downward from the dorsum with smooth convexity to where it is abruptly cut off by postero-ventral truncation; overlap greatest on ventral border, less at antero-ventral and postero-ventral margins; surface smooth, evenly convex. Length, .58 mm.; height, .28 mm.; thickness, .19 mm.

Holotype.—Indiana University Paleontological Collections No. 2093.

Deese formation, locality 98, about eight miles northwest of Ardmore, Oklahoma.

This species is very similar to *B. hoxbarana,* n. sp., and *B. deesensis,* n. sp. It may be differentiated from both by its greater slenderness; from the first by the shorter, straight part of the ventral border, and difference in convexity of the valves; from the second by the difference in height, and the anterior extremity which is sharply rounded and below the median line in *B. deesensis.*

Bythocypris sasakwaensis, Warthin Plate 7, figs. 13a, b

Bythocypris sasakwaensis Warthin, 1930, Okla. Geol. Surv., Bull. 53, p. 73, pl. 6, figs. 5a, b. (Holdenville formation, Sasakwa limestone member, Sasakwa, Oklahoma.)

Carapace reniform in lateral view; greatest height central; dorsal border highly convex, almost semicircular from one extremity to the other; anterior end and extremity low, entirely below center of carapace; ventral border concave, greatest concavity anterior to center; posterior extremity roundly angulated, below center of carapace, but about in center of posterior end; overlap strong on dorsal margin, narrowing toward the extremities, about half as great on the ventral margin where it also decreases toward the extremities; surface smooth. Length, 1.17 mm.; height, .75 mm.

Plesiotype.—Indiana University Paleontological Collections No. 2016.

Hoxbar formation, Confederate member, locality 47, abundant, three miles south of Ardmore, Oklahoma.

This species, which Warthin listed only from the Sasakwa limestone, where it was common, has been found only in the Confederate limestone.

Bythocypris angularis, n. sp. Plate 7, figs. 14a, b

Carapace small, length about 1.7 times height; greatest height and thickness slightly posterior to center; dorsal margin not smoothly arched, more convex at greatest height, and rather sharply angled where the margin bends suddenly downward to the anterior and posterior ends; anterior end narrowly rounded at the middle; ventral margin sinuate, convex at point of greatest height, concavity in front of this, and back of it a long straight slope up to the sharply angulated posterior end; overlap strongest on dorsal and ventral borders, small elsewhere; surface smooth. Length, .65 mm.; height, .37 mm.; thickness, .25 mm.

Holotype.—Indiana University Paleontological Collections No. 2092.

Deese formation, locality 126, three and one-half miles south of Ardmore, Oklahoma.

This form is most closely related to *B. deesensis,* n. sp., from which it may be distinguished by the difference in dorsal outline, the greater angularity in lateral outline, the more highly arched dorsal margin, and more acutely angled and ventrally truncated posterior end.

Bythocypris cooki, n. sp. Plate 8, figs. 1a, b

Carapace small, suboblong to subreniform in lateral view; length 1.8 times height; greatest height central; greatest length below center; greatest thickness posterior; dorsal margin flatly convex, posteriorly dropping almost straight downward to form the posterior truncated end, anteriorly beginning to curve rapidly downward about one-third the distance from the anterior end and merging smoothly into the low, broadly rounded anterior end; ventral margin nearly straight, slightly concave just anterior to the middle; surface granulose; overlap even all around except on dorsal margin where it becomes practically nil. Length, .62 mm.; height, .34 mm.; thickness, .22 mm.

Holotype.—Indiana University Paleontological Collections No. 2011.

Deese? formation, locality 80, about eight miles northwest of Ardmore, Oklahoma. Also locality 74, about eight miles northwest of Ardmore.

Similar to *B. centralis* Coryell and Billings, but greatest thickness definitely in posterior end rather than central, and anterior extremity much lower.

This species is named in honor of the late Prof. C. W. Cook, University of Michigan, Ann Arbor, Michigan.

Bythocypris scapha Coryell and Billings Plate 8, figs. 2a, b

Bythocypris scapha Coryell and Billings, 1932, Am. Mid. Nat., vol. 13, No. 4, p. 174, pl. 17, fig. 10. (Wayland shale, five miles east of Cisco, Texas.)

Carapace, short, high, subreniform in lateral view; greatest height central or slightly anterior to center; dorsal margin rounded, more steeply toward anterior end where it merges into the broadly rounded anterior margin; ventral margin concave slightly anterior to center; posterior end distinctly lower than anterior, highly rounded dorsally, and meeting the upcurved posterior end of the ventral margin at almost a right angle; surface smooth; left valve overlaps right all around. Length, .64 mm.; height, .36 mm.; thickness, .23 mm.

Plesiotype.—Indiana University Paleontological Collections No. 2012.

Deese? formation, locality 80, eight miles northwest of Ardmore, Oklahoma.

This species agrees almost perfectly with *B. scapha* from the Wayland shale, except that the greatest thickness seems to be posterior instead of central.

Bythocypris? irregularis, n. sp. Plate 8, figs. 3a, b

Carapace, short, high, subreniform in lateral view; greatest height slightly anterior of center; greatest thickness central; dorsal margin not evenly rounded, postero-dorsal slope straight, long, reaching anteriorly well past the middle where it joins with a slightly rounded angle the shorter, steep, slightly convex antero-dorsal portion; anterior end produced in slightly rounded right angle a little below the median line; ventral margin sharply concave near middle on both sides of which it is markedly convex, antero-ventral slope truncated, straight; posterior end well rounded but truncated ventrally; overlap greatest near middle of ventral margin and on antero-ventral slope, slight all around posterior end, and entirely absent along the long, straight, posteriorly sloping dorsum; surface smooth, evenly convex. Length. .65 mm.; height, .35 mm.; thickness, .23 mm.

Holotype.—Indiana University Paleontological Collections No. 2090.

Deese? formation, locality 78, about eight miles northwest of Ardmore. Oklahoma.

This species considerably resembles *B. scapha* at first glance. However, its irregular outline, and lack of overlap at the dorsal margin serve to distinguish it. This deficiency in overlap was observed on several specimens and therefore is not due to poor preservation. The species should probably be placed in the new genus *Healdiacypris,* since Brady's description indicated that *Bythocypris* should have both dorsal and ventral overlap. The overlap on several specimens of this species was carefully studied under different magnifications up to and including x102.

Bythocypris frivola, n. sp. Plate 8, figs. 5a, b

Carapace elongate, more than twice as long as high; greatest height about central; greatest thickness in posterior half; dorsal margin trilobed, or convex just anterior to center with concave areas on either side; anterior end rounded but not evenly; ventral margin also lobed, with two convex areas, point of greatest convexity about a third the distance from the anterior end; posterior end drawn out with a downward pointing, bluntly rounded beak; overlap greatest on the ventral margin, small but even elsewhere; surface finely granulose to smooth. Length, .71 mm.; height,

.33 mm.; thickness, .26 mm.

Holotype.—Indiana University Paleontological Collections No. 2006.

Deese? formation, locality 80, about eight miles northwest of Ardmore, and about .7 miles north of Deese school.

This form does not resemble any described species. The carapace is very thin on the ventral and antero-ventral margin and is often broken and crumpled upward, increasing the concavity already present on the ventral margin. Only two specimens out of a dozen or more appeared to be free from ventral distortion.

Bythocypris pediformis Knight Plate 8, figs. 6a, b

Bythocypris pediformis Knight, 1928, Jour. Pal., vol. 2, p. 326, pl. 44, figs. 3a-c. (Upper Fort Scott Limestone, St. Louis County Missouri.) — Warthin, 1930, Okla. Geol. Surv., Bull. 53, p. 74, pl. 6, figs. 6a, b. (Range uncertain, since he probably included several different forms in this species. Holdenville to Wetumka.) —Coryell and Sample, 1932. Am. Mid. Nat., vol. 13, no. 5, p. 267, pl. 25, fig. 18. (East Mountain shale, Mineral Wells, Texas.)

Carapace small, subpediform in lateral view; length 1.75 times height; greatest height slightly posterior to center; greatest thickness in posterior half; posterior-dorsal and dorsal border merged into a single smooth curve, becoming more convex immediately above the center and then straightening out slightly toward the anterior to form the antero-dorsal slope; anterior evenly and broadly rounded; ventral margin convex, greatest convexity where the margin bends upward to the sharply rounded, low, angular, posterior extremity; overlap greatest on ventral margin, small but even elsewhere; surface smooth. Length, .49 mm.; height, .28 mm.; thickness, .21 mm.

Plesiotype.—Indiana University Paleontological Collections No. 2086.

Hoxbar formation, locality 60, just above the Westheimer member, six miles south and two and one-fourth miles east of Ardmore, Oklahoma.

Bythocypris subreniformis, n. sp. Plate 8, figs. 7a, b

Carapace small, reniform in lateral view; greatest height central; greatest thickness about one-fourth the distance from posterior end, very blunt posteriorly in dorsal view; dorsal margin lowly and symmetrically arched, merging indistinguishably into the end margins; anterior end broadly rounded, extremity below median; ventral border concave; posterior less broadly rounded than anterior, unsymmetrical, extremely high, slightly above median; overlap even, but narrow all around; surface smooth. Length, .51 mm.; height, .27 mm.; thickness, .22 mm.

Holotype.—Indiana University Paleontological Collections No. 2131.

Hoxbar formation, Union Dairy limestone, locality 22, two and one-half miles south of Ardmore, Oklahoma.

This form is undoubtedly very closely related to *B. fabulites* Warthin. The dorsal margin is less arched, the anterior extremity is low instead of high as in Warthin's form, and it is a third less in size. Warthin's figure of *B. fabulites* (*B. rotunda* Warthin, 1930, renamed *B. fabulites* Warthin, 1932, in Coryell and Osorio, Am. Mid. Nat., vol. 13, No. 2, p. 35.) shows it to be concave ventrally, but the description reads "ventral border slightly convex, the margin of the right valve being straight". The word "convex" may have been an error. Both valves are unquestionably concave in the species here described.

Pythocypris hoxbarana, n. sp. Plate 8, figs. 8a, b

Carapace small, subovate, elongate in lateral view, elongate oval in dorsal view; greatest height and thickness central; dorsal margin evenly convex, rounding sharply downward at each end; anterior broadly rounded, extremity about median or slightly above; ventral margin long, straight, with slight tendency to be concave; postero-ventral region truncated, causing a sharp angle of about 100° at the posterior extremity, and an obtuse angle of about 145° where the plane of truncation intersects ventral margin; overlap greatest on ventral margin, slightly less, but even, elsewhere; surface smooth, evenly convex; shell usually white, almost translucent with muscle spots often clearly shown. Length, .62 mm.; height, .34 mm.; thickness, .26 mm.

Holotype.—Indiana University Paleontological Collections No. 2066.

Hoxbar formation, locality 5, just above the Daube limestone, about six miles south, and three miles east of Ardmore, Oklahoma.

Bythocypris subpediformis, n. sp. Plate 8, figs. 9a, b

Carapace small, subpediform in lateral view; length 1.78 times height (holotype); greatest height central; greatest thickness one-third the distance from the posterior end; posterior end smoothly rounded, not truncated postero-ventrally; dorsal margin highest and sharply convex about center at which point the dorsal margin is broken into two parts, the dorso-posterior slope, and the larger antero-dorsal slope, both nearly straight; anterior end broadly and smoothly rounded; ventral border slightly and evenly convex; overlap greatest at center of ventral margin, very small on postero-dorsal slope; surface smooth. Length, .52 mm.; height, .29 mm.; thickness, .23 mm.

Holotype.—Indiana University Paleontological Collections No. 2091.

Hoxbar formation, locality 60, about six miles south and two and one-fourth miles east of Ardmore, Oklahoma. Also Deese formation, locality 126.

Distinguished from *B. pediformis* by the broadly rounded posterior end without any trace of postero-ventral truncation, and the difference in dorsal outline.

Bythocypris mytiliformis, n. sp. Plate 8, figs. 10a, b

Carapace small, pediform in lateral view, length about twice height; greatest height posterior to center; greatest length below center, obliquely across the shell, from postero-ventral angle to anterior extremity; dorsal margin convex, strongly so on posterior half, but nearly straight on anterior half; anterior end well rounded, extremity high; ventral margin long, nearly straight, slight concavity about one-third way from anterior end; posterior end acute, sharply angled, truncated postero-ventrally; overlap even, slightly stronger on ventral margin; surface smooth, evenly convex, greatest thickness central. Length, .585 mm.; height, .29 mm.; thickness, .19 mm.

Holotype.—Indiana University Paleontological Collections No. 2126.

Hoxbar formation, locality 7, just below the Daube limestone, six miles south and three miles east of Ardmore, Oklahoma.

This species bears a considerable resemblance to *Krithe cushmani* Alexander, from the Cretaceous of north Texas. In the latter species, however, in dorsal view, the posterior end is blunt and incised at the middle.

Genus HEALDIACYPRIS, n. gen.

Genoholotype, *Healdiacypris perplexa,* n. sp. (Pennsylvanian, Deese formation, eight miles northwest of Ardmore, Oklahoma, .6 mile north of Deese school.)

Carapace small, subovate; dorsal margin arched, truncated at upper half of postero-dorsal slope which reflects the short straight hinge line; greatest height anterior to center; greatest length about median; left valve largest, overlap rather wide for the size of the form, widest on ventral margin and anterior end, lacking on the upper half of the postero-dorsal slope.

Range, Middle Pennsylvanian.

This new genus seems to be a transition form between *Healdia* and *Bythocypris.* It lacks the spines and typical bulge of *Healdia* and the postero-dorsal truncation is too high. It differs from *Bythocypris* in not having dorsal overlap, but the straight, short hinge line instead. Perhaps *Bythocypris? irregularis,* n. sp., should be included in this genus, but owing to its great similarity to many Pennsylvanian species of *Bythocypris* it has, for the present, been left in this genus.

Healdiacypris perplexa, n. sp. Plate 8, figs. 13a, b

Carapace small, inflated, subovate in lateral and dorsal views; dorsal margin highly arched, truncated at upper half of postero-dorsal slope, reflecting the short, straight hinge line; hinge line depressed, resulting in a short furrow as seen from above; greatest height anterior to center, about one-third the way from the anterior extremity; greatest length slightly below the center; left valve largest; overlap wide, greatest on ventral margin and anterior end, lacking on upper half of the postero-dorsal slope; surface evenly convex, finely punctate. Length, .53 mm.; height, .32 mm.; thickness, .27 mm.

Holotype.—Indiana University Paleontological Collections No. 2089.

Deese? formation, locality 78, .6 mile north of Deese school, and about eight miles northwest of Ardmore, Oklahoma.

Genus WAYLANDELLA Coryell and Billings, 1932

Genotype. *Waylandella spinosa,* Coryell and Billings, 1932, Am. Mid. Nat., vol. 13, p. 175, pl. 17, fig. 7. (Wayland shale, 5 miles east of Cisco, Texas.)

Waylandella deesensis, n. sp. Plate 8, figs. 11a, b

Carapace small, semiovate in lateral view; dorsal margin convex; ventral margin nearly straight, but slightly convex; ends of about equal height; greatest height at middle; greatest length median; left valve overlaps right rather widely all around, least postero-ventrally and at anterior margin; posterior healdoid spines small. Length, .65 mm.; height, .36 mm.; thickness, .24 mm.

Holotype.—Indiana University Paleontological Collections No. 2097.

Deese formation, locality 98, one mile north and one-half mile east of Deese school, about eight miles northwest of Ardmore, Oklahoma.

Genus MACROCYPRIS Brady, 1865

This genus is similar to *Bairdia* and *Bythocypris*, but is more elongate, and is reversed in overlap.

Macrocypris delicatula, n. sp. Plate 8, figs. 12a, b, c, d

Carapace small, elongate, boat-shaped in lateral view, lanceolate in dorsal view; dorsal margin gently convex from one extremity to the other; ventral margin nearly straight; anterior end rounded, extremity low; posterior end sharply pointed; greatest thickness posterior to middle; greatest length low, almost to ventral margin; greatest height in middle half; overlap of right valve small, indeterminate due to distortion or slipping of valves; surface smooth. Length, .7 mm.; height, .23 mm.; thickness, .18 mm.

Holotype.—Indiana University Paleontological Collections No. 2079.

Hoxbar formation, locality 60, six miles south and two and one-fourth miles east of Ardmore, Oklahoma.

Genus HEALDIA Roundy, 1926

Genotype, *Healdia simplex* Roundy, 1926, U. S. Geol. Survey, Prof. Paper 146, p. 8, pl. 1, figs. 11a-c. (Graham formation of Texas.)

Carapace small, subovate to subtriangular in lateral view; dorsal margin curved, almost angular in the middle, postero-dorsal slope truncate; antero-dorsal slope gently curved and rounding off into the broadly curved anterior end; posterior margin more sharply rounded; slightly in front of the posterior end is a swollen area on each valve which is not well differentiated from the shell contour in front, but conspicuous on the rear; ventral margin nearly straight in its middle portion, rounding off into the ends; left valve larger than the right, overlapping on all sides except on the postero-dorsal slope, where the overlap is usually slight; one or two backward pointing spines may be seen on the posterior bulge; left valve shows a distinct groove for the reception of the right; surface smooth.

Healdia aff. ampla Roundy Plate 9, figs. 1, 2

Healdia aff. *ampla* Roundy, 1926, U. S. Geol. Survey, Prof. Paper 146, p. 8, pl. 1, figs. 12a-13. (Limestone immediately under Barnett shale.)

Carapace subovate in lateral view; dorsal margin gently curved; postero-dorsal slope slightly concave; ends smoothly rounded, nearly equal, or anterior slightly broader than posterior; ventral margin slightly concave; posterior bulge prominent but smooth, inconspicuous on anterior side, but steep posteriorly; dorsal and ventral spines both developed on the bulge; surface smooth.

Measurements of a right valve, and a left valve: Length, .75 mm.; height, .41 mm.; Length, .72 mm.; height, .39 mm.

Plesiotypes.—Indiana University Paleontological Collections Nos. 2163 and 2164.

Dornick Hills formation, shale below the Otterville limestone, locality 155, four miles north and two miles west of Ardmore, Oklahoma.

This form appears to be a little higher anteriorly than is typical *H. ampla.*

Healdia caneyensis Harlton Plate 8, fig. 14

Healdia caneyensis Harlton, 1927, Jour. Pal., vol. 1, p. 208, pl. 33, figs. 2a, b. —Harlton, 1929, Am. Jour. Sci., 5 ser. vol. 18, p. 261, pl. 1, figs. 9a-e. (Springer formation, Carter County, Oklahoma.) —1933, Jour. Pal., vol. 7, p. 26, pl. 7, fig. 10. (Johns Valley shale, southeastern Oklahoma.)

Carapace large for the genus, subovate in lateral view; ends smoothly rounded, posterior slightly wider than anterior; posterior-dorsal slopes distinct; ventral margin concave at middle; greatest height at middle; greatest length near median; greatest thickness in posterior half; overlap even all around; surface smooth; spines small. Length, 1 mm.; height, .56 mm.

Plesiotype.—Indiana University Paleontological Collections No. 2161.

Lower Dornick Hills formation, locality 161, about two miles northwest of Berwyn, Oklahoma.

Healdia oblonga, n. sp. Plate 9, figs. 4a, b

Carapace oblong in lateral view; dorsal margin arched, anterior and posterior slopes convex; ventral margin smoothly convex; ends rounded, greatest convexities near the median line; greatest length median; greatest height at the middle; greatest thickness in the posterior half; posterior bulge not prominent; spines very small; overlap absent for a short way on the postero-dorsal slope, very broad ventrally; surface smooth. Length, .71 mm.; height, .36 mm.; thickness, .28 mm.

Holotype.—Indiana University Paleontological Collections No. 2095.

Deese formation, locality 98, one mile north and three-quarters mile east of Deese School, about eight miles northwest of Ardmore, Oklahoma.

Healdia sp. Plate 9, figs. 6, 7, 8

Carapace subtriangular in lateral view; dorsal margin sharply angled; anterior-dorsal and postero-dorsal slopes straight and about equal in length; posterior end rather narrowly rounded; anterior end more broadly rounded, extremity high; ventral margin convex to concave?; posterior bulge prominent; surface smooth; no spines.

Numerous single valves have been found in the Jolliff and Otterville limestones, lower Dornick Hills formation, which appear to belong to one species, or perhaps two very closely related species. All of these more or less fit the description given above. Some, namely those from the Otterville limestone, seem to be more narrow posteriorly, and a little more convex ventrally. Those from the Jolliff limestone appear broader both anteriorly and posteriorly, and straighter ventrally, nevertheless they all have a characteristically similar appearance. Valves very similar, but bearing slender spines occur in the shale below the Otterville limestone, at locality 155.

The figured specimen from the Otterville limestone, locality 148, had the following measurements: Length, .78 mm.; height,

.5 mm. No. 2116.

The specimens from the Jolliff limestone, locality 160, had the following measurements: Length, .77 mm.; height, .48 mm. No. 2112. Length, .71 mm.; height, .46 mm. No. 2113.

Specimens.—Indiana University Paleontological Collections Nos. 2116, 2112, and 2113.

Healdia bendana, n. sp. Plate 9, figs. 3a, b

Carapace subovate in lateral view; small; dorsal margin arched; postero-dorsal slope long, straight, truncate; antero-dorsal slope convex; anterior end much higher than posterior, margin broadly rounded; posterior end narrowly but smoothly rounded near the median line; ventral margin straight to slightly concave; greatest length slightly above the median line; greatest thickness one-third the length from the posterior end; greatest height anterior to the center; posterior bulge prominent; spines short, heavy, knob-like, seeming to originate at a common point, giving a V-like appearance, not distinctly separated from the bulge except near the ends; overlap very slight, absent postero-dorsally; surface smooth. Length, .47 mm.; height, .29 mm.; thickness, .22 mm.

Holotype.—Indiana University Paleontological Collections No. 2166.

Dornick Hills formation, locality 161, shale 50 feet below Otterville limestone, about two miles northwest of Berywn, Oklahoma.

Healdia aff. bythocyproidea Warthin Plate 9, figs. 9a, b

Healdia bythocyproidea Warthin, 1930, Okla. Geol. Survey, Bull. 53, p. 76, pl. 6, figs. 12a, b. (Wewoka formation, east-central Oklahoma.)

Carapace suboval in lateral view; greatest height central, greatest length median; greatest thickness near the middle, although the posterior end is nearly as thick; anterior and posterior dorsal slopes both slightly convex; ends smoothly rounded; ventral margin nearly straight or slightly concave; overlap fairly even, greater anteriorly, and absent near the middle of the postero-dorsal slope; no spines; surface smooth. Length, .64 mm.; height, .31 mm.; thickness, .21 mm.

Plesiotype.—Indiana University Paleontological- Collections

No. 2096.

Deese formation, locality 98, about eight miles northwest of Ardmore, Oklahoma.

Numerous specimens were found at this locality, but most of them were badly mashed. The figured specimen seemed free of distortion, but a portion had been broken from the ventral margin.

Healdia formosa Harlton Plate 9, fig. 10

Healdia formosa Harlton, 1928, Jour. Pal., vol. 2, no. 2, p. 135, pl. 21, fig. 7. (Gaptank, Pecos County, Texas.) —Warthin, 1930, Okla. Geol. Survey, Bull. 53, p. 77, pl. 6, fig. 13a b. (Wewoka, East-central Oklahoma.) —Coryell and Sample, 1932, Am. Mid. Nat., vol. 13, p. 270, pl. 26, fig. 7. (East Mountain shale, Mineral Wells, Texas.)

Carapace elongate, suboval in lateral view; greatest height near middle; anterior and posterior ends smoothly rounded, anterior broader than posterior; ventral margin straight; greatest thickness slightly posterior of middle; spines very long, curved slightly inward toward each other. Length, .75 mm.; height, .41 mm.

Plesiotype.—Indiana University Paleontological Collections No. 2015.

Deese? formation, locality 80, .7 mile northwest of Deese School, about eight miles northwest of Ardmore, Oklahoma.

This species may be the same as *H. limacoidea* Knight.

Healdia bovicornis, n. sp. Plate 9, fig. 14

Carapace elongate, subovate to subreniform in lateral view; dorsal border only slightly convex, posterior margin curving sharply downward to the low, sharp, postero-ventral extremity; anterior evenly rounded; ventral margin concave, greatest concavity about one-third the length from posterior end; spines very long, sharp, curved. Length, .71 mm.; height, .38 mm.

Holotype.—Indiana University Paleontological Collections No. 2000.

Deese? formation, locality 80.

This curious form resembles no other species of *Healdia* known to the writer.

Healdia deesensis, n. sp. Plate 9, fig. 15

Carapace bluntly subtriangular in lateral view; greatest height at middle, where dorsal margin is sharply angulated; greatest length near median line; slightly oblique, anterior extremity high, narrowly rounded; posterior margin broadly rounded, ventral border slightly concave; spines short, very thick, blunt; surface finely granulose. Length, .74 mm.; height, .44 mm.

Holotype.—Indiana University Paleontological Collections No. 2014.

Deese? formation, locality 80, .7 mile northwest of Deese School, about eight miles northwest of Ardmore, Oklahoma.

Healdia? arca, n. sp. Plate 9, figs. 5a, b

Carapace broad, curved suboval or subreniform in lateral view, thin, lanceolate in dorsal view; dorsal margin broadly arched, ends smoothly rounded, posterior more broadly so than anterior; ventral margin concave; greatest height at middle; greatest length median; greatest thickness one-third the length from posterior end; overlap greatest on ventral margin; no posterior bulge or spines; surface smooth. Length, .76 mm.; height, .47 mm.; thickness, .27 mm.

Holotype.—Indiana University Paleontological Collections No. 2101.

Deese? formation, locality 80, .7 mile northwest of Deese School, about eight miles northwest of Ardmore, Oklahoma.

The generic relationship of this species is somewhat doubtful. It lacks the typical bulge, furrowed posterior dorsal slope, and spines of *Healdia*.

Healdia ehlersi, n. sp. Plate 9, figs. 11a, b

Carapace ovate-subdeltoid in lateral view; dorsal margin roundly angular, postero-dorsal slope very slightly concave, antero-dorsal slope convex; greatest length median; greatest height central; greatest thickness only slightly posterior of center; ends evenly rounded; ventral margin concave; overlap absent anteriorly where the edge of the left valve is elevated in a marginal rim; posterior-dorsal bulge very prominent with well developed spines, the dorsal one usually the longer; surface smooth. Length, .64 mm.; height, .4 mm.; thickness, .32 mm.

Holotype.—Indiana University Paleontological Collections No. 2105.

Deese? formation, locality 80, about eight miles northwest of Ardmore, Oklahoma.

This species somewhat resembles *H. elegans* Warthin, but differs in the more broadly rounded posterior end, the nearly straight postero-dorsal slope, the smaller dorsal overlap, and the concave ventral margin. It lacks the postero-ventral truncation of *H. angulata,* n. sp., and has well developed spines, whereas the latter species has no spines of consequence.

This species is named for Professor G. M. Ehlers of the University of Michigan.

Healdia angulata, n. sp. Plate 9, figs. 12a, b, 13

Carapace angular, modified subdeltoid in lateral view, obesely lanceolate in dorsal view; dorsal margin angulated, both slopes steep, straight; ventral margin concave; posterior end truncated postero-ventrally, extremity high, sharply rounded; anterior end sharply rounded near median line; greatest height slightly anterior of center; greatest thickness only slightly posterior of middle; overlap conspicuous all around, less anteriorly and postero-ventrally; posterior ridge very prominent; no spines, except occasionally a tiny spine developed at the lower end of posterior ridge; anterior edge of right valve elevated in a rounded keel; surface smooth. Length, .83 mm.; height, .54 mm.; thickness, .37 mm.

Holotype.—Indiana University Paleontological Collections No. 2104.

Deese? formation, locality 80, .7 mile northwest of Deese School, about eight miles northwest of Ardmore, Oklahoma.

This species is distinguished from *H. squamosa* Harlton by the postero-ventral truncation.

Healdia cara, n. sp. Plate 9, figs. 16a, b

Carapace subovate to subtriangular in lateral view; highest point on the dorsal margin well anterior to center; antero-dorsal slope long, gently convex; postero-dorsal slope slightly convex along upper part, but very sharply incised adjacent to the posterior end; posterior end smoothly rounded but truncate dorsally; anterior end narrowly rounded and lower than the posterior end; ventral border convex; overlap very small dorsally and anteriorly, but distinct ventrally and posteriorly; posterior-dorsal bulge prominent; no spines; a distinct ridge on the right valve bordering the anterior margin; postero-dorsal furrow distinct, in which the commissure line appears sharply undulatory when viewed from above; greatest height anterior to center; greatest length median; greatest thickness in the posterior half. Length, .55 mm.; height, .35 mm.; thickness, .23 mm.

Holotype.—Indiana University Paleontological Collections No. 2099.

Deese? formation, locality 78, .6 mile north of Deese School, about eight miles northwest of Ardmore, Oklahoma.

Healdia carterensis, n. sp. Plate 10, figs. 6a, b

Carapace small, subovate in lateral view; dorsal margin gently arched, with the greatest height near the middle; antero-dorsal slope slightly convex; postero-dorsal slope gently concave; anterior margin evenly rounded; posterior margin smoothly rounded with the extremity low, between the lower spines, ventral margin gently concave; overlap distinct all around, even, becoming slightly greater mid-ventrally; posterior bulge defined by a prominent, sharp ridge bearing a spine postero-dorsally and postero-ventrally on each valve; posterior end very blunt in dorsal view; surface smooth. Length, .52 mm.; height, .28 mm.; thickness, .21 mm.

Holotype.—Indiana University Paleontological Collections No. 2165.

Deese? formation, locality 80, .7 mile northwest of Deese School, Carter County, Oklahoma.

Healdia cf. glennensis Harlton Plate 9, figs. 17, 18

Healdia glennensis Harlton, 1927, Jour. Pal., vol. 1, p. 209, pl. 33, figs. 6a, b. (Upper Glenn, Love County, Oklahoma.)

Carapace ovate-subdeltoid in lateral view; greatest length median; greatest height near middle; greatest thickness about one-third the length from posterior end; dorsal margin sharply angular, anterior slope slightly convex, posterior slope long, slightly concave; anterior end rather squarely but evenly rounded; posterior end more narrowly rounded, truncated slightly ventrally; ventral margin convex; overlap uneven, small anteriorly, postero-ventrally and postero-dorsally, greatest ventrally and antero-dorsally; two spines developed on each valve; surface smooth. Length, .83 mm.; height, .54 mm.; thickness, .4 mm.

Plesiotype.—Indiana University Paleontological Collections No. 2108.

Hoxbar formation, 175 feet above the Confederate limestone, locality 25, one and three-quarters miles south of Ardmore, Oklahoma.

This form differs from typical *H. glennensis* Harlton by being truncate postero-ventrally and having both spines developed.

Occurring in the same sample were forms similar, but more slender, truncated more postero-ventrally, straighter ventrally, and having much longer spines. This may be a distinct species or a sexual variation. The specimen figured has the following measurements: Length, .79 mm.; height, .45 mm.

Plesiotype.—Indiana University Paleontological Collections No. 2109.

Healdia humilis, n. sp. Plate 9, figs. 19a, b

Carapace very small, ovate-subdeltoid in lateral view; dorsal margin sharply angular, highest point anterior to center; antero-dorsal slope straight; postero-dorsal slope concave; ventral margin convex; posterior end truncate postero ventrally; greatest length obliquely from the high rounded posterior extremity to the middle of the rather blunt anterior end; greatest height anterior to center; greatest thickness slightly posterior to center; posterior bulge poorly developed; overlap very slight, absent postero-dorsally; anterior edge of right valve has a small ridge; surface smooth, evenly convex; no spines. Length, .44 mm.; height, .28 mm.; thickness, .19 mm.

Holotype.—Indiana University Paleontological Collections No. 2117.

Hoxbar formation, locality 60, six miles south and two and one-quarter miles east of Ardmore, Oklahoma.

This tiny ostracod is among the smallest of the species of *Healdia.* The average length is less than .4 mm., the figured specimen being the largest one which could be found. It may easily be distinguished from *H. simplex,* which it resembles, by the much smaller size, smaller overlap, lack of posterior bulge, and squarer anterior end.

Healdia ciscoensis Harlton Plate 9, figs. 20a, b

Healdia ciscoensis Harlton, 1927, Jour. Pal., vol. 1, p. 208, pl. 33, fig. 4. (Cisco, just below Sedwick limestone, Coleman County, Texas.) —1929, Am. Jour. Sci., 5th ser., vol. 18, p. 265, pl. 2, fig. 6. —Warthin, 1930, Okla. Geol. Survey, Bull. 53, p. 75, pl. 6, figs. 8a, b. (Holdenville and Wewoka formations, east-central Oklahoma.)

Carapace small, wide, suboval in lateral view; greatest height near middle; greatest length median; greatest thickness one-fifth the length from posterior end; dorsal margin roundly arched, postero-dorsal slope concave near posterior end; anterior smoothly rounded; posterior margin truncated dorsally; ventral margin nearly straight at middle portion; surface granulose; no spines. Length, .49 mm.; height, .34 mm.; thickness, .21 mm.

Plesiotype.—Indiana University Paleontological Collections No. 2114.

Hoxbar formation, locality 12, south edge of Ardmore, Oklahoma.

Healdia simplex Roundy Plate 10, figs. 1a, b

Healdia simplex Roundy, 1926, U. S. Geol. Surv., Prof. Paper 146, p. 8, pl. 1, figs. 11a-c. (Barnett shale, Texas.) —Coryell and Sample, 1932, Am. Mid. Nat., vol. 13, p. 179, pl. 17, fig. 15. (East Mountain shale, Mineral Wells, Texas.)

Carapace small, ovate-subdeltoid in lateral view; postero-dorsal slope concave; antero-dorsal slope very slightly convex; anterior margin evenly rounded; ventral margin convex; posterior end truncated postero-ventrally, high extremity narrowly rounded; overlap distinct, except on furrowed posterior dorsal slope, greatest ventrally; surface smooth; no spines; bulge prominent. Length, .51 mm.; height, .31 mm.; thickness, .22 mm.

Plesiotype.—Indiana University Paleontological Collections No. 2098.

Hoxbar formation, locality 60, six miles south and two and one-quarter miles east of Ardmore, Oklahoma.

At locality 69, Deese formation, a variety occurs which has very tiny spines. This widely ranging species was also found at locality 126, Deese formation, and in a sample near the Daube limestone, Hoxbar formation.

Healdia cuneiformis, n. sp. Plate 10, figs. 2a, b

Carapace small, subovate in lateral view, wedge-shaped in dorsal view; dorsal margin gently arched; postero-dorsal slope short, sharply concave; ends rounded, more sharply near the median line, anterior end much wider than posterior; ventral margin straight; overlap very slight dorsally, greatest ventrally and posteriorly; dorsal bulge prominent; greatest length median; greatest height near the middle; greatest thickness about one-fifth the length from the posterior end; surface smooth; no spines. Length, .45 mm.; height .25 mm.; thickness, .16 mm.

Holotype.—Indiana University Paleontological Collections No. 2100.

Hoxbar formation, locality 60, six miles south and two and one-quarter miles east of Ardmore, Oklahoma.

Healdia nucleolata Knight Plate 10, figs. 5a, b

Healdia nucleolata Knight, 1928, Jour. Pal., vol. 2, p. 329, pl. 44, fig. 4. (Upper Fort Scott limestone, St. Louis County, Missouri) —Warthin, 1930, Okla. Geol. Surv., Bull. 53, p. 75, pl. 6, figs. 9a, b. (Wewoka, Wetumka formations, east-central Oklahoma.)

Carapace small, subovate in lateral view, similar to *H. simplex*. It differs from that species in the less obliquity of the outline, smaller overlap, less pronounced postero-ventral truncation, less concave and more narrowly furrowed postero-dorsal slope, and less convex ventral margin. Length, .52 mm.; height, .32 mm.; thickness, .25 mm.

Plesiotype.—Indiana University Paleontological Collections No. 2110.

Hoxbar formation, locality 8, near Daube limestone horizon, two and one-half miles south, and three-quarters miles east of Ardmore, Oklahoma. Also at locality 60, about 75 feet above the Westheimer member.

Healdia ovata, n. sp. Plate 10, figs. 4a, b

Carapace almost perfectly ovate in lateral view, with only a very slight postero-dorsal truncation; dorsal and ventral margins smoothly convex; ends evenly rounded; greatest height at middle; greatest length median; greatest thickness near middle, although posterior end is sharply inflated; overlap even, only slightly greater dorsally and ventrally; no spines; surface smooth. Length, .48 mm.; height, .28 mm.; thickness, .21 mm.

Holotype.—Indiana University Paleontological Collections No. 2111.

Hoxbar formation, locality 8, two and one-half miles south and three-quarters miles east of Ardmore, Oklahoma.

Healdia alba Coryell and Billings Plate 10, figs. 3a, b

Healdia alba Coryell and Billings, 1932, Am. Mid. Nat., vol. 13, p. 178, pl. 18, fig. 13. (Wayland shale, 5 miles east of Cisco, Texas.) —Coryell and Sample, 1932, Am. Mid. Nat., vol. 13, p. 270, pl. 26, fig. 3. (East Mountain shale, Mineral Wells, Texas.)

Carapace very small, subovate in lateral view; dorsal margin high, sharply rounded at middle, nearly straight anteriorly, slightly concave posteriorly; posterior margin narrowly rounded; anterior margin broadly rounded; ventral margin slightly convex; posterior bulge poorly defined; spines well developed, posterior-dorsal spines point upward and are located on ridges on each side of postero-dorsal furrow; overlap narrow; greatest height central, greatest length median; surface smooth. Length, .37 mm.; height, .24 mm.; thickness, .17 mm.

Plesiotype.—Indiana University Paleontological Collections No. 2065.

Hoxbar formation, near Daube limestone horizon, locality 8, two and one-half miles south and three-quarters mile east of Ardmore, Oklahoma.

This species may be distinguished by the very minute size and the position of the postero-dorsal spines.

Genus SEMINOLITES Coryell, 1928

Genotype, *Seminolites truncatus* Coryell, 1928, Jour. Pal., vol. 2, no. 2, p. 88, pl. 11, fig. 1.

"Small, inequivalved, subtriangular ostracods with arched hinge line, highest in the anterior half; the left valve overlaps the right on the entire margin; the ventral edge is nearly straight or broadly convex with curved extremities; the end of the valves are rounded with a rather distinct truncation of the anterior ventral contact; the surface of each valve is marked by several large irregularly distributed circular pits and a curved ridge near each end that approximately parallels the marginal contacts; a shallow sinus occurs adjacent to the ridge on its concave side."

Seminolites aff. truncatus Coryell Plate 10, fig. 9

Seminolites truncatus Coryell, 1928, Jour. Pal., vol. 2, no. 2, p. 88, pl. 11, fig. 1. (Wewoka formation, Oklahoma.)

Carapace subtriangular in lateral view; greatest height only slightly in front of the center; greatest length median; greatest thickness about central; antero-dorsal and postero-dorsal slopes about equal in length and very straight; posterior end sharply truncate; anterior end sharply angled at the point of greatest length; ventral border slightly concave; valve surface smooth except for a few circular pits; posterior ridge prominent, anterior ridge low, obscure; overlap even, small, slightly greater mid-ventrally. Length, .52 mm.; height, .32 mm.

Plesiotype.—Indiana University Paleontological Collections No. 2103.

Deese? formation, locality 80, about eight miles northwest of Ardmore, Oklahoma.

This form differs from typical *S. truncatus* by being more angular, and concave instead of convex ventrally.

Seminolites aff. elongatus Coryell Plate 10, figs. 7a, b

Seminolites elongatus Coryell, 1928, Jour. Pal., vol. 2, no. 2, p. 88, pl. 11, fig. 2. (Holdenville formation, Oklahoma.)

Carapace subtriangular in lateral view; highest point on the dorsal margin anterior to center; antero-dorsal slope short, straight; postero-dorsal slope long, straight; anterior end smoothly rounded; posterior end blunt, truncate, making a distinct angle with the posterior dorsal slope; ventral margin slightly concave; overlap small, greatest ventrally; surface smooth except for a few irregularly placed circular pits; a rather sharp, elevated ridge encircles the posterior end, and a low, broad ridge the anterior end. Length, .74 mm.; height, .43 mm.; thickness, .32 mm.

Plesiotype.—Indiana University Paleontological Cellections No. 2002.

Deese? formation, locality 80, about eight miles northwest of Ardmore, Oklahoma.

This form is relatively higher than typical *S. elongatus*, and is a little more concave vertically.

Seminolites healdoides, n. sp. Plate 10, fig. 8

Carapace small, subtriangular in lateral view; antero-dorsal slope short, convex; postero-dorsal slope long, straight; greatest height anterior to center; ends evenly rounded; anterior much broader than posterior; ventral margin straight; overlap slight; surface smooth except for a few round pits; posterior ridge prominent, bearing postero-dorsally and postero-ventrally small healdoid spines; anterior ridge low, broad. Length, .43 mm.; height, .24 mm.

Holotype.—Indiana University Paleontological Collections No. 2102.

Deese? formation, locality 89, about eight miles northwest of Ardmore, Oklahoma.

Seminolites kosomensis Harlton Plate 10, fig. 11

Seminolites kosomensis Harlton, 1933, Jour. Pal., vol. 7, p. 27, pl. 7, figs. 4a, b. (Johns Valley shale, southeastern Oklahoma.)

Carapace oblong-subtriangular in lateral view; greatest height slightly anterior to the middle; antero-dorsal and postero-dorsal slopes nearly straight, the latter slightly the longer; ends very evenly rounded, the anterior slightly broader than the posterior; ventral margin long, nearly straight; ends bordered by symmetrically curved, distinct ridges; surface smooth except for a few obscure circular pits. Length, .58 mm.; height, .29 mm.

Plesiotype.—Indiana University Paleontological Collections No. 2169.

Dornick Hills formation, locality 155, four miles north and two miles west of Ardmore, Oklahoma. Also present in other samples from the Otterville limestone down to the top of the Springer formation.

The Ardmore basin specimens seem to be somewhat smaller than Harlton's specimens, but are otherwise quite similar. The circular pits were not mentioned by Harlton, but they could easily have been absent from his specimens, due to poor preservation. Nearly all of the specimens examined by the writer failed to show the pits.

Seminolites? pushmatahensis Harlton Plate 10, fig. 10

Seminolites pushmatahensis Harlton, 1933, Jour. Pal., vol. 7, p. 26, pl. 7, figs. 5a, b. (Johns Valley shale, southeastern Oklahoma.)

Carapace subelliptical in lateral view; greatest height slightly anterior to center; antero-dorsal slope straight; postero-dorsal slope straight or slightly concave; ventral margin nearly straight, slightly convex just posterior to middle; anterior end broadly and evenly rounded; posterior end rather square, sharply truncate postero-ventrally; posterior ridge most prominent in the postero-ventral angle, and gradually fading into the convexity of the valve surface in the postero-dorsal region; anterior ridge conspicuous, symmetrically encircling the anterior edge of the valve, hiding the commissure line on the right side; overlap small on the dorsal and end margins, but becoming greater ventrally; surface smooth, no pits were observed. Length, .79 mm.; height, .41 mm.

Plesiotype.—Indiana University Paleontological Collections No. 2170.

Dornick Hills formation, locality 162, shale immediately below the Otterville limestone, about two miles northwest of Berwyn, Oklahoma. Also at several other localities between the Otterville limestone and the top of the Springer formation.

This form is quite similar to Harlton's type of the species, although the anterior end is somewhat broader, and the greatest height a little more anterior. The nature of the posterior ridge, the lowly arched dorsal margin, the sharp postero-ventral angle, and the lack (?) of pits, would make this species appear to be intermediate between *Harltonella,* n. gen., and the lower Pennsylvanian type of *Seminolites,* which in turn gave rise to the more characteristic *Seminolites* of middle Pennsylvanian time.

Genus HARLTONELLA, n. gen.

Genotype, *Harltonella ardmorensis,* n. sp.

Carapace small, subelliptical to suboval in lateral view; dorsal margin lowly arched; greatest height may be at middle or toward either end, with either anterior or posterior end the broader; anterior margin smoothly rounded; posterior margin may be slightly rounded, or vertically truncate, and always truncate postero-ventrally; ventral margin nearly straight, but may be slightly convex or concave; a prominent ridge arises from the extreme postero-ventral corner of the valve, curving upward and forward, disappearing in the convexity of the valve surface; left valve larger than the right, overlapping the right slightly all around; in dorsal view the posterior end is very blunt and square, the thickness at the very end being nearly, but not quite, as great as the maximum, while the anterior end is quite pointed; from the ventral side the posterior ridges are much more evident.

Some species of this genus resemble *Bythocypris,* but differ in possessing the posterior ridge. The genus differs from *Seminolites* in outline, the absence of the anterior ridge, and the absence of the circular pits. Also, the posterior ridge is unlike that of *Seminolites.* The resemblance to *Healdia* is very slight. The posterior ridge is much too close to the margin to simulate the posterior bulge of that genus, the postero-dorsal truncation is wanting, and there does not seem to be any tendency on any of the species to develop spines.

The known range is Lower Pennsylvanian.

The genus is named for Mr. Bruce Harlton of Tulsa, Oklahoma, who has described many important Pennsylvanian Ostracoda.

Harltonella ardmorensis, n. sp. Plate 10, figs. 12a, b

Carapace small, suboval in lateral view; dorsal margin lowly arched, greatest height anterior to center; anterior end broader than posterior, with margin smoothly and evenly rounded; posterior margin oblique, slanting upward and forward, gently convex, and truncate posteriorly; ventral margin gently concave; a prominent ridge arising from the postero-ventral corner of the valve, curving upward and forward, disappearing in the convexity of the valve surface; left valve overlapping the right slightly all around, most ventrally; surface smooth. Length, .65 mm.; height, .33 mm.; thickness, .24 mm.

Holotype.—Indiana University Paleontological Collections No. 2107.

Dornick Hills formation, locality 152, shale between the Lester and Otterville limestones, three and one-half miles north and two miles west of Ardmore, Oklahoma.

Harltonella macropleura, n. sp. Plate 10, fig. 14

Carapace small, elongate, subelliptical in lateral view; dorsal margin long, gently convex, nearly straight at the middle portion, and slopes forward from the highest point, which is about one-third the length from the posterior end; anterior end narrower than posterior, with margin smoothly rounded; posterior margin nearly a semicircular arc from the postero-ventral corner of the valve to about one-third the length from the posterior end; ventral margin long, gently concave; posterior ridge begins at the extreme lower corner of the valve, and slopes upward and forward toward the point of greatest height, broadening meanwhile, and disappears in the convexity of the valve surface; surface smooth. Length, .62 mm.; height, .26 mm.

Holotype.—Indiana University Paleontological Collections No. 2167.

Lower Dornick Hills formation, locality 161, about two miles northwest of Berwyn, Oklahoma.

Harltonella elongata, n. sp. Plate 10, fig. 13

This species somewhat resembles *H. macropleura*, but may be distinguished by several important differences. The shell is larger, thicker, and much less delicate than that of *H. macropleura*, the greatest height is anterior instead of posterior, and the posterior ridge follows the marginal outline much more closely than in *H. macropleura*. Length, .72 mm.; height, .31 mm.

Holotype.—Indiana University Paleontological Collections No. 2168.

Dornick Hills formation, locality 155, four miles north and two miles west of Ardmore, Oklahoma.

Harltonella robusta, n. sp. Plate 10, fig. 15

Carapace subovate in lateral view; dorsal margin convexly arched; anterior end much narrower than posterior, margin evenly rounded; posterior margin smoothly rounded, but sharply truncate ventrally; ventral margin nearly straight, slightly convex just posterior to the middle; posterior ridge not well differentiated on the anterior side, but the posterior slope very steep; a very faint, broad depression extends across the valve about one-fifth the length from the anterior end; greatest height and thickness posterior to the middle; greatest length median; surface smooth. Length, .75 mm.; height, .42 mm.

Holotype.—Indiana University Paleontological Collections No. 2175.

Dornick Hills formation, locality 162, immediately below the Otterville limestone, about two miles northwest of Berwyn, Oklahoma.

Family CYTHERELLIDAE Sars, 1865

Carapace ovate to subovate in lateral view; right valve the larger, overlapping the left all around; greatest thickness near the middle or in the posterior half, depending upon the genus; marginal ridges sometimes present at or near the ends; surface smooth.

In this paper four genera are placed in this family: *Cytherella, Cavellina, Sulcella,* and *Cavellinella,* n. gen.

Cytherella and *Cavellina* are recognized as different genera, although they may quite possibly represent only a case of sexual dimorphism. Two individuals of the same species might therefore be referred not only to different species, but to different genera. There appears to be no way out of this difficulty that might not result in endless confusion, and render these abundant forms of even less value than they have at the present time. Because of the absence of readily discernible characters they appear to have been shunned by most workers. Since the difference in outline, distribution of overlap, and the position of greatest thickness seem to vary as much between the sexes as between different species, it seems highly unlikely that when several forms are present at the same locality, one could correctly associate together the males and females of a species. It is even less likely that one would correctly associate together two sex variants of the same species from different horizons and localities. By separate treatment, and careful figuring they promise, because of their very abundance, to become valuable to micro-paleontologists in the future.

Genus CYTHERELLA Jones, 1849

Cytherella Jones, 1849, Pal. Soc. Mono., p. 28.

Carapace suboval or subelliptical in lateral view; anterior margin usually more broadly and symmetrically rounded than posterior margin; greatest thickness slightly posterior to the center; right valve larger than the left overlapping the left completely; surface smooth, without ornamentation, ridges or sulci.

Cytherella jolliffana, n. sp. Plate 10, figs. 16a, b

Carapace suboval in lateral view; greatest height distinctly posterior to center; greatest thickness central; greatest length median; valves equally inflated; dorsal border unsymmetrically arched, the anterior slope long, nearly straight, and the posterior slope short, steep, and slightly concave; anterior end broad and symmetrically rounded; posterior end narrowly and unsymmetrically rounded; ventral border very slightly convex; overlap broad all around except on the anterior margin, greatest ventrally, and on the antero-dorsal slope; surface smooth. Length, 1.24 mm.; height, .7 mm.; thickness, .54 mm.

Holotype.—Indian University Paleontological Collections No. 1992.

Dornick Hills formation, Jolliff limestone member, locality 160, about two miles northwest of Berwyn, Oklahoma.

Cytherella berwynensis, n. sp. Plate 10, figs. 17a, b

Carapace small for the genus, broadly subovate in lateral view; greatest height slightly posterior to center; greatest thickness about one-third the length from the posterior end; greatest length median; valves evenly inflated; dorsal border unsymmetrically arched, slopes both short, anterior slope nearly straight, posterior slope slightly convex; anterior margin broadly and symmetrically rounded; posterior end rather broadly but unsymmetrically rounded; ventral margin strongly convex; overlap narrow anteriorly but broad elsewhere; the commissure line is very straight ventrally, and sharply angled postero-ventrally; surface smooth. Length, .85 mm.; height, .63 mm.; thickness, .39 mm.

Holotype.—Indiana University Paleontological Collections No. 2043.

Lower Dornick Hills formation, Jolliff limestone member, locality 160, about two miles northwest of Berwyn, Oklahoma.

Cytherella ottervillica, n. sp. Plate 11, figs. 1a, b

Carapace ovate in lateral view; greatest height central; greatest thickness posterior to center, valves unsymmetrically convex, the point of greatest convexity on the right valve being posterior to the point of greatest convexity on the left; dorsal border slightly more convex than the ventral border; anterior margin broadly and very symmetrically rounded; posterior margin smoothly but more convexly rounded than the anterior; overlap greatest dorsally and ventrally; highest point dorsally on the commissure line is only slightly posterior to center, ventral commissure nearly straight and the farthest posterior extension of the commissure symmetrical with the farthest posterior extension of the posterior margin; surface smooth. Length, 1 mm.; height, .68 mm.; thickness, .48 mm.

Holotype.—Indiana University Paleontological Collections No. 2044.

Dornick Hills formation, Otterville limestone member, locality 146, about seven miles south of Ardmore, Oklahoma.

Cytherella ottervillica, var. obesa, n. var. Plate 10, figs. 18a, b

Very similar to *C. ottervillica.* It differs in being more obese, more symmetrically ovate in lateral view, and slightly wider in proportion to the length. The commissure line is less sharply angled, the highest point dorsally lying farther to the posterior than in *C. ottervillica,* and the ventral commissure is not quite so long and straight. Length, 1.07 mm.; height, .7 mm.; thickness, .54 mm.

Holotype.—Indiana University Paleontological Collections No. 2049.

Dornick Hills formation, Otterville limestone, locality 147, about seven miles south of Ardmore, Oklahoma. This variety is from the lower part of the Otterville, while *C. ottervillica* is from the upper part of the Otterville.

Cytherella brevisulcata, n. sp. Plate 11, figs. 2a, b

Carapace subovate in lateral view; greatest height anterior to center; greatest thickness slightly posterior to center; greatest length slightly above the center; valves about equally inflated, the contour of the right valve in dorsal view being somewhat more smoothly rounded than that of the left; the dorsal border is unsymmetrically arched, the antero-dorsal portion being short and slightly convex, and the posterior portion being long and nearly straight; anterior end evenly rounded; posterior end rather square, extremity high and narrowly rounded; ventral border convex; overlap rather strong dorsally at the place of greatest height, and along the ventral margin; anterior margin of left valve bordered by a rather distinct ridge; a faint sulcus may be observed in the dorsal portion of the valve just below the highest point on the commissure line; surface smooth. Length, 1.06 mm.; height, .66 mm.; thickness, .41 mm.

Holotype.—Indiana University Paleontological Collections No. 2038.

Dornick Hills formation, locality 152, three and one-half miles north and two miles west of Ardmore, Oklahoma.

This species is tentatively referred to the genus *Cytherella.* It lacks the high posterior marginal inflation necessary for the genus *Sulcella.*

Cytherella brevis, n. sp. Plate 11, figs. 4a, b

Carapace broadly subovate in lateral view, very short in proportion to the height; greatest height near the middle; greatest thickness slightly posterior to the center; greatest length median; rather thin in dorsal view, valves evenly inflated, the right slightly more than the left; dorsal border roundly arched, both slopes smoothly rounded, the posterior one somewhat steeper; anterior margin very broadly rounded; posterior margin less broadly rounded than anterior with extremity below the median; ventral border nearly straight, very slightly convex; overlap very wide, greatest dorsally; anterior portion of the dorsal commissure nearly straight, paralleling the straight ventral commissure line; surface smooth. Length, 1.07 mm.; height, .75 mm.

Holotype.—Indiana University Paleontological Collections No. 2050.

Dornick Hills formation, Otterville limestone member, locality 146, about seven miles south of Ardmore, Oklahoma.

Cytherella cavellinoides, n. sp. Plate 11, figs. 3a, b

Carapace subovate in lateral view, and slender but cavellinoid in dorsal view; dorsal margin sharply arched near the middle portion, both slopes being only very slightly convex to where they round into the end margins; greatest length very slightly above the center; greatest thickness near the middle; anterior end smoothly rounded; posterior end broad, but unsymmetrically rounded with the extremity high; ventral margin nearly straight; valves nearly equally inflated with the posterior marginal slopes very steep; overlap rather narrow, greatest dorsally and ventrally; anterior margins of both valves have slight keels; surface smooth. Length, 1.34 mm.; height, .78 mm.; thickness, .45 mm.

Holotype.—Indiana University Paleontological Collections No. 2005.

Deese? formation, locality 80, about eight miles northwest of Ardmore, Oklahoma.

Cytherella laevis, n. sp. Plate 11, figs. 5a, b

Carapace elongate suboval in lateral view, flattened subrhomboidal in dorsal view; greatest height about one-third the length from the posterior end; greatest thickness posterior to the center; greatest length median; valves evenly inflated; dorsal border flatly arched, postero-dorsal slope short, steep and straight; anterior margin broadly rounded; posterior margin much more narrowly rounded, appearing somewhat truncate dorso-anteriorly and vento-anteriorly; ventral margin long, only slightly convex; overlap distinct all around, greatest ventrally and antero-ventrally; ventral commissure straight, dorsal commissure slightly concave on the antero-dorsal slope; surface smooth. Length, 1.02 mm.; height, .57 mm.; thickness, .37 mm.

Holotype.—Indiana University Paleontological Collections No. 2078.

Hoxbar formation, locality 55, six miles south and two and one-quarter miles east of Ardmore, Oklahoma.

This is a more elongate form which occurs in the lower Hoxbar in rather constant association with *C. gloria*.

Cytherella lirata, n. sp. Plate 11, figs. 6a, b

Carapace elongate, suboval in lateral view; greatest height central; greatest thickness about central; greatest length obliquely above the center; valves unevenly inflated, the greatest convexity on the left valve being in front of the middle, and on the right valve, back of the middle; dorsal border distinctly arched, slopes about equal and only slightly convex; anterior end broadly rounded; posterior end rather square, truncated dorso-posteriorly; ventral border long, nearly straight; overlap very small, greatest dosally; a small furrow is present in the postero-ventral region, about one-fifth the length from the posterior end; surface smooth. Length, 1.3 mm.; height, .73 mm.; thickness, .45 mm.

Holotype.—Indiana University Paleontological Collections No. 2039.

Hoxbar formation, locality 5, just above the Daube limestone, six miles south, and three miles east of Ardmore, Oklahoma. This form resembles *C. cavellinoides.* It differs in the more sharply angled dorso-posterior margin, the postero-ventral furrow, and the absence of anterior marginal keels. The overlap is also less.

Cytherella daubeana, n. sp. **Plate 11, figs. 8a, b**

Carapace elongate, suboval in lateral view, flatly rhomboidal in dorsal view; greatest height near the middle; greatest length median; greatest thickness just posterior to the center; valves unequally inflated, the greatest convexity on the right being slightly posterior to that on the left; dorsal margin lowly arched, slopes about equal, slightly convex; ends about equally rounded; ventral border slightly convex in the anterior portion; overlap distinct, greatest dorsally and ventrally; dorsal commissure line slightly convex, greatest height central; ventral commissure line concave; surface smooth. Length, 1.17 mm.; height, .63 mm.; thickness, .45 mm.

Holotype.—Indiana University Paleontological Collections No. 2067.

Upper Hoxbar formation, locality 8, near the horizon of the Daube limestone, two and one-half miles south and three-quarters miles east of Ardmore, Oklahoma.

Cytherella aff. gloria Coryell and Sample **Plate 11, figs. 7a, b; 10-15**

Cytherella benniei intermedia Jones, Kirkby, and Brady, 1884. Pal. Soc. Mono., p. 78, pl. 7, fig. 7. (Upper Coal Measures, Iowa.) (Homonym of *Cytherella intermedia* Bornemann, 1855.)

Cytherella intermedia Warthin, 1930, Okla. Geol. Surv., Bull. 53, p. 78,

pl. 7, figs. 1a, b. (Holdenville, Wewoka, east-central Oklahoma.)
Cytherella gloria Coryell and Sample, 1932, Am. Mid. Nat., vol. 13, p. 271, pl. 26, fig. 14. (East Mountain shale, Texas.)

Carapace small, subelliptical in lateral view; flatly subrhomboidal in dorsal view; greatest height slightly posterior to the middle; greatest length through the center but slightly oblique; greatest thickness slightly posterior to the center; valves unevenly inflated, the greatest convexity on the right valve lying distinctly posterior to the greatest convexity on the left valve; dorsal border sharply arched just posterior to the middle, both slopes very nearly straight; anterior border broadly rounded, but the extremity slightly below median; posterior margin sharply rounded, appearing somewhat truncate dorso-anteriorly and ventro-anteriorly; ventral margin convex; overlap greatest dorsally and ventrally; dorsally, the highest point on the commissure line is slightly in front of the highest point on the margin; ventrally, the commissure line is straight, and distinctly angled where it turns sharply into the short, straight ventro-anterior portion; surface smooth. Length, .9 mm.; height, .56 mm.; thickness, .38 mm.

Plesiotype.—Indiana University Paleontological Collections No. 2070.

Lower Hoxbar formation, locality 55, about six miles south and two and one-half miles east of Ardmore, Oklahoma.

These forms differ from the type of *C. gloria* in the position of greatest height, in being shorter, and more convex ventrally.

The tremendous abundance of this *Cytherella* in the Lower Hoxbar formation, and the consequently large number of young individuals present, has made possible an ontogenetic study. Figures 7b, 10-15, show dorsal outlines of individuals of this species arranged according to size. The outstanding fact which is apparent is that the position of greatest thickness gradually becomes closer to the posterior end as the size decreases, so that the younger individuals have outlines more like *Cavellina* than *Cytherella*. This would suggest thtat *Cavellina* is more primitive than *Cytherella,* and might also be considered a valid argument that *Cavellina* is a female *Cytherella*. An outstanding difficulty in this particular case, however, is that while this *Cytherella* is extremely abundant in several samples, specimens of *Cavellina* are rare, and the only species of *Cavellina* available is *Cav-*

ellina aff. *pulchella.* It would seem rather unusual for a species which is so extremely abundant to be represented almost entirely by male individuals. Another possibility, and a much more plausible one, if one must search for sexual dimorphism, is that *Cytherella laevis,* n. sp. is the male of this species. The two occur together in several cases, and the ratio is about 15 to 1, *Cytherella* aff. *gloria* being the more abundant. Still another possibility is that *C.* aff. *gloria,* var. *alta,* n. var., is the male of this species. Its association with this species is more limited, however, the two occurring together in only two samples.

Cytherella aff. gloria var. alta, n. var. Plate 11, figs. 19a, b

This form greatly resembles *C.* aff. *gloria,* but is much higher in proportion to its length. The dorsal margin is more broadly rounded and the highest point dorsally on the commissure line is more to the anterior than in *C.* aff. *gloria.* Length, .96 mm.; height, .63 mm.; thickness, .37 mm.

Holotype.—Indiana University Paleontological Collections No. 2040.

Lower Hoxbar formation, locality 53, six miles south and two and one-quarter miles east of Ardmore, Oklahoma.

Cytherella tongia Coryell and Sample Plate 11, figs. 9a, b

Cytherella tongia Coryell and Sample, 1932, Am. Mid. Nat., vol. 13, p. 271, pl. 26, fig. 11. (East Mountain shale, Mineral Wells, Texas.)

Carapace broadly curved, subelliptical in lateral view; greatest height near the middle of the valve; greatest length slightly oblique, but through the center; greatest thickness central; valves unevenly inflated, the greatest convexity on the left valve lying ahead of the greatest convexity on the right; dorsal border broadly and evenly arched, slopes about evenly convex; anterior end broadly rounded, but the extremity below the median; posterior margin as broadly rounded as the anterior, but the extremity above the median; ventral border slightly concave; overlap distinct all around, very broad ventrally; dorsal commissure broadly arched in harmony with the dorsal margin, while the ventral commissure is slightly more concave than the ventral margin; surface smooth. Length, 1.13 mm.; height, .66 mm.; thickness, .41 mm.

Plesiotype.—Indiana University Paleontological Collections No. 2042.

Lower Hoxbar formation, locality 53, about six miles south and two and one-quarter miles east of Ardmore, Oklahoma.

Genus CAVELLINA Coryell, 1928

Genotype, *Cavellina pulchella* Coryell, 1928, Jour. Pal., vol. 2, no. 2, p. 89.

This genus differs from *Cytherella* by having an interior partition which partially separates the posterior one-third of the body cavity from the rest and in having the position of greatest thickness near the posterior end.

Cavellina robusta, n. sp. Plate 11, figs. 18a, b

Carapace broad, thick, and heavy shelled; nearly oval in lateral view; greatest height slightly posterior to the middle; greatest length median; greatest thickness in the posterior half; valves unevenly inflated, the point of greatest convexity on the right valve being posterior to that on the left; dorsal border broadly arched, slopes about equally convex; anterior end broadly and symmetrically rounded; posterior end broadly rounded, but more convex near the median line; ventral border slightly convex; overlap greatest ventrally; commissure line long, straight, or slightly concave ventrally; dorsally, the highest point is about one-third the length from the posterior end with the anterior portion long and straight; surface granulose. Length, 1.26 mm.; height, .75 mm.; thickness, .56 mm.

Holotype.—Indiana University Paleontologcial Collections No. 1993.

Lower Dornick Hills formation, Jolliff limestone locality 160, about two miles northwest of Berwyn, Oklahoma. Also locality 149, Jolliff limestone.

This form may be the female of *Cytherella jolliffana,* n. sp.

Cavellina subpulchella Coryell Plate 11, figs. 20a b

Cavellina subpulchella Coryell, 1928, Jour. Pal., vol. 2, no. 2, p. 93, pl. 11, fig. 9. (Boggy shale, Oklahoma.)

Carapace subovate in lateral view; greatest height near the middle; greatest length median; greatest thickness about one-third the length from the posterior end; valves unequally inflated, the greatest convexity on the right valve lying posterior to that on the left; dorsal border sharply arched, both slopes nearly straight; anterior margin very evenly rounded; posterior extremity sharply rounded and slightly above the median line; ventral border strongly convex; overlap very wide ventrally and antero-dorsally; commissure line long and straight ventrally, converging anteriorly to a marked degree with the long, straight dorsal portion of the commissure line; surface smooth. Length, 1.18 mm.; height, .7 mm.; thickness, .49 mm.

Plesiotype.—Indiana University Paleontological Collections No. 2046.

Deese formation, locality 126, three and one-half miles south of Ardmore, Oklahoma.

Cavellina minuta, n. sp. Plate 11, figs. 16a, b, 17

Carapace very small, broadly subovate in lateral view; greatest height near the middle; greatest thickness near the posterior end; greatest length about median; dorsal border nearly flat for the anterior two-thirds, very steep posteriorly, giving a truncate appearance to the postero-dorsal area; anterior end broadly rounded, nearly as broad as the carapace at the middle; posterior end much more narrowly but smoothly rounded; ventral margin only slightly convex; overlap small, least postero-ventrally; surface smooth. Length, .46 mm.; height, .31 mm.; thickness, .21 mm.

Holotype.—Indiana University Paleontological Collections No. 2013.

Deese (?) formation, locality 80, about .7 mile northwest of Deese School, Carter County, Oklahoma.

This minute cytherelloid form occurred rather abundantly at the above locality. The fact that the specimens were similar in size and without any intermediate forms to connect them to some other species, lead to the conclusion that these were not young individuals, but the adults of a species.

The holotype, although better preserved than the average specimen, failed to show in dorsal view the sharp convexity of the posterior portion of the valve which was characteristic of many of the specimens. An outline drawing (Fig. 17) was made to illustrate this.

Cavellina ? bisecta, n. sp. Plate 12, figs. 1a, b

Carapace thick, broad, suboval in lateral view; greatest height near the middle; greatest length median; greatest thickness about one-third the length from the posterior end; dorsal border strongly but roundly arched; anterior end broadly rounded; posterior end broad but acutely rounded near the median line; ventral border strongly convex; overlap slight anteriorly and posteriorly but very strong dorsally and ventrally; commissure line broadly arched dorsally but nearly straight ventrally; a broad shallow sulcus crosses each valve just anterior to the middle; surface smooth. Length, .7 mm.; height, .44 mm.; thickness, .32 mm.

Holotype.—Indiana University Paleontological Collections No. 2048.

Dornick Hills formation, Otterville limestone, locality 146, about seven miles south of Ardmore, Oklahoma.

Cavellina pulchella, Coryell Plate 12, figs. 2a, b

Cavellina pulchella Coryell, 1928, Jour. Pal., vol. 2, p. 90, pl. 11, fig. 5. (Seminole and Holdenville formations, Oklahoma.) —Warthin, 1930, Okla. Geol. Surv., Bull. 53, p. 78, pl. 7, figs. 3a, b. (Holdenville formation, Oklahoma.) —Coryell and Billings, 1932, Am. Mid. Nat., vol. 13, p. 181, pl. 17, fig. 16. (Wayland shale, Texas.) —Coryell and Sample, 1932, Am. Mid. Nat., vol. 13, p. 273, pl. 26, fig. 15. (East Mountain shale, Mineral Wells, Texas.)

Carapace subelliptical in lateral view; greatest height near the middle; greatest length median; greatest thickness at the posterior end; dorsal border lowly arched, slopes poorly developed; anterior margin broadly rounded; posterior margin narrowly rounded at the median line; vental border slightly convex; overlap greatest ventrally and antero-dorsally, where the commissure lines are long, straight and converge anteriorly; surface smooth. Length, .88 mm.; height, .5 mm.; thickness, .38 mm.

Plesiotype.—Indiana University Paleontological Collections No. 2045.

Deese formation, locality 126, three and one-half miles south of Ardmore, Oklahoma.

Cavellina aff. Pulchella Coryell Plate 12, figs. 5a, b

This form differs from *C. pulchella* in being broader, a little more convex dorsally and ventrally and more truncate ventroposteriorly. Length, 1.07 mm.; height, .65 mm.; thickness, .46 mm.

Plesiotype.—Indiana University Paleontological Collections No. 2069.

Lower Hoxbar formation, locality 55, six miles south and about two and one-quarter miles east of Ardmore, Oklahoma.

Cavellina expansa, n. sp. Plate 12, figs. 3a, b

Carapace elongate, subelliptical in lateral view; greatest height slightly posterior to the center; greatest length nearly median; greatest thickness near the posterior end; dorsal border smoothly arched; but posterior slope much steeper than anterior slope; anterior end broadly and symmetrically rounded; posterior margin sharply rounded at the middle portion, truncate dorso-anteriorly and ventro-anteriorly so that the extremity is nearly a right angle; ventral border nearly straight but very slightly convex; overlap narrow, with no appreciable increase dorsally or ventrally; commissure line long, straight ventrally and broadly arched dorsally with the highest point coinciding with the point of greatest height; surface smooth. Length, 1.15 mm.; height, .63 mm.; thickness, .53 mm.

Holotype.—Indiana University Paleontological Collections No. 2041.

Lower Hoxbar formation, locality 53, six miles south and two and one-quarter miles east of Ardmore, Oklahoma.

This form shows relationship to *C. jejuna* Coryell and Sample, but differs in the much narrower overlap and in the point of greatest height. It differs from *C. lata* in the more sharply rounded posterior margin and in the less broad anterior end. It also resembles *C. pulchella* but differs in the much smaller overlap, in the long, straight ventral margin, and in the sharp ventro-posterior truncation.

Cavellina polita, n. sp. Plate 12, figs. 4a, b

Carapace suboval in lateral view; dorsal margin irregularly arched with greatest height slightly posterior to the middle; greatest length near the median; greatest thickness near the posterior end; valves unevenly inflated, the greatest convexity on the right valve lying slightly posterior to the greatest convexity on the left; antero-dorsal slope concave; anterior margin very broadly rounded; posterior margin narrowly rounded, with the extremity slightly above the median line; ventral margin convex, the point of greatest convexity lying anterior to the middle; commissure line nearly straight ventrally, slightly concave dorsally; overlap greatest dorsally and ventrally; surface smooth. Length, 1.02 mm.; height, .6 mm.; thickness, .4 mm.

Holotype.—Indiana University Paleontological Collections No. 1994.

Lower Hoxbar formation, locality 60, six miles south and two and one-quarter miles east of Ardmore, Oklahoma.

This form resembles *C. jejuna* Coryell and Sample but differs in the much narrower overlap, the convex ventral margin, the position of greatest height, and in being much shorter in proportion to the height. It also resembles *C. wewokana* Warthin but differs in the position of greatest height, in the more narrowly rounded posterior margin, and in being much more sharply inflated posteriorly.

Cavellina laevissima, n. sp. Plate 12, figs. 6a, b; 7a, b

Carapace subovate in lateral view; greatest height nearly central; greatest length median, slightly oblique; greatest thickness about one-fourth the length from the posterior end; dorsal border sharply arched at the middle, both slopes nearly straight; anterior end broadly and symmetrically rounded; posterior end more narrowly but not sharply rounded; ventral margin slightly convex; overlap widest dorsally and ventrally; commissure line straight ventrally, arched dorsally with the point of greatest height distinctly posterior to the position of greatest height on the margin; surface smooth. Length, 1.04 mm.; height, .63 mm.; thickness, .42 mm.

Holotype.—Indiana University Paleontological Collection No. 2068.

Hoxbar formation, near Daube limestone, locality 8, about two and one-half miles south and three-quarters of a mile east of Ardmore, Oklahoma.

This species shows relationship to *C. pulchella* but differs in being shorter in proportion to the height, more sharply arched dorsally and in being more broadly rounded posteriorly. Single valves of this species are extremely abundant at this horizon.

Figure 7a shows a right valve drawn from the right side. Figure 7b is an interior view of the same valve showing the channeling and also the deep posterior cavity which is partially separated from the middle and anterior portion of the body cavity. Measurements of this valve are as follows: length, 1.17 mm.; height, .67 mm.

Cavellina, sp. Plate 12, figs. 8a, b

A few elongate characteristically shaped left valves have been found throughout the Hoxbar formation. So far no right valves have been found which seem to possess the right channeling to receive them. They appear much too elongate to belong to *C. polita*, n. sp., or *C.* aff. *pulchella*, Coryell. Since they appear to be characteristic of the Hoxbar formation, figures have been included. Measurements of the figured valve are as follows: length, 1.15 mm.; height, .56 mm.

Specimen.—Indiana University Paleontological Collections No. 2074.

Genus SULCELLA Coryell and Sample, 1932

Sulcella Coryell and Sample, 1932, Am. Mid. Nat., vol. 13, No. 5, p. 274.
Sansabelloides Harris and Lalicker, 1932, Am. Mid. Nat., vol. 13, No. 7, p. 402, pl. 37, figs. 4a, b.

Genotype, *Sulcella sulcata* Coryell and Sample, by original designation, op. cit., p. 275, pl. 26, fig. 18.

Sulcella harrisi, n. sp. Plate 12, figs. 9, 10a, b

Jonesina texana Warthin (not *Jonesina texana* Harlton), 1930, Okla. Geol. Surv., Bull. 53, p. 60, pl. 4, fig. 10. (Wewoka formation, east-central Oklahoma.)
Sansabelloides texana Harris and Lalicker, 1932, Am. Mid. Nat., vol. 13, No. 7, pl. 37, figs. 4a, b. (Francis formation, Ada, Oklahoma.)

Warthin, in 1930, described a form from the Wewoka formation which he erroneously identified as *Jonesina texana* Harlton. Subsequent work has shown that this species is not properly referred to *Jonesina,* since it has complete dorsal overlap and is therefore a sulcated cytherelloid form. Coryell and Sample erected the new genus *Sulcella* to receive two similar species from the Mineral Wells formation of Texas, one of which was named *Sulcella warthini.* This species they considered identical with the one described and figured by Warthin. The writer, however, believes the two to be different. The dorsal outline is different, the anterior extremity of the Texas form is low instead of median and the sulcus much deeper, extending downward from the dorsal commissure line, back of the middle, whereas the Oklahoma forms show hardly any trace of a sulcus but a very deep pit located near the middle and only slightly above the median line. For these reasons it seems best to apply the name *Sulcella warthini* to the species from the Mineral Wells formation. This is permissible since they made a new species but did not designate a holotype. Later Harris and Lalicker proposed the new generic name *Sansabelloides* to receive the misidentified species of Warthin. Their specimen came from the Francis formation but in all characteristics it is identical with Warthin's specimen. They credited the species to Warthin, *Sansabelloides texana* (Warthin), which was, of course, inadmissible, since Warthin had no intention of making a new species. They designated their own specimen as holotype but failed to make a new species. For these Oklahoma specimens, one of which was described by Warthin as *Jonsina texana* Harlton and another as *Sansabelloides texana* (Warthin), by Harris and Lalicker, I propose the name *Sulcella harrisi,* n. sp., in honor of the senior author, designating as the holotype No. 564, University of Oklahoma Paleontological Collections.

Carapace cytherelloid in outline and contact of valves; dorsal margin slightly convex, sometimes with a slight angulation posterior to middle; ventral margin straight or very slightly concave; anterior end symmetrically rounded; posterior margin smoothly rounded, extremity high; anterior edge of valves bordered by a distinct ridge; surface smooth, marked by a deep, vertically elongate, oval pit slightly above the center of the shell; above pit in some specimens may be a very faint, shallow sulcus; greatest thickness near the posterior end, marked by a ridge; posterior marginal slope extremely steep. Length, .74 mm.; height, .4 mm.

Plesiotype.—Indiana University Paleontological Collections No. 2106.

Dornick Hills formation, locality 152, three and one-half miles north and two miles west of Ardmore, Oklahoma.

A variety occurring in the lower Hoxbar, locality 60, is apparently identical, except that faint pits may be seen on the steep posterior slope. Length, .88 mm.; height, .44 mm.; thickness, .25 mm.

Plesiotype.—Indiana University Paleontological Collections No. 1982.

Genus CAVELLINELLA, n. gen.

Genotype, *Cavellinella casei,* n. sp. (Dornick Hills formation, southern Oklahoma.)

Carapace oval to suboval in lateral view; greatest thickness near the posterior end; dorsal border arched; anterior margin broadly rounded; posterior margin more sharply rounded; ventral margin convex; valves unequal, the right the larger, overlapping the left all around, but most on the dorsal and ventral margins; a pronounced lunate ridge encircles the posterior end of each valve about one-fifth the length from the posterior end; surface smooth.

Cavellinella casei, n. sp. **Plate 12, figs. 11a, b**

Carapace nearly oval in lateral view; greatest height near the middle; greatest length median; greatest thickness near the posterior end; dorsal margin broadly arched, both slopes slightly convex but the posterior slope the steeper; anterior margin very broadly and symmetrically rounded; posterior end less broad than anterior, with the margin rather narrowly rounded at the median line; ventral margin nearly as convex as the dorsal margin; overlap slightly greater dorsally and ventrally; commissure line convex ventrally, nearly straight dorsally with the highest point well back of the middle; a pronounced lunate ridge, shallow anteriorly but very steep posteriorly encircles the posterior end of each valve about one-fifth the length from the end; surface smooth. Length, .59 mm.; height, .37 mm.; thickness, .24 mm.

Holotype.—Indiana University Paleontological Collections No. 2047.

Dornick Hills formation, Otterville limestone member, locality 146, about seven miles south of Ardmore, Oklahoma. Also at locality 160, Jolliff limestone about two miles northwest of Berwyn, Oklahoma.

This species is named in honor of Professor E. C. Case, University of Michigan, Ann Arbor, Michigan.

OSTRACODA OF UNCERTAIN POSITION

Genus CYATHUS Roth and Skinner, 1930

Genotype *Cyathus ulrichi* Roth and Skinner, 1930, Jour. Pal., vol. 4, p. 347, pl. 28, figs. 5-18. (McCoy formation, Colorado.)

Carapace very small, obese, more or less canoe-shaped; hinge line long, straight, depressed; ends rounded, cardinal angles obtuse; ventral margin convex; valves apparently equal; surface covered by a system of concentric faintly osculating and bifurcating riblets, which parallel the free margin and the hinge line and are concentric about a point roughly coinciding with the arch of maximum breadth.

The writer was not able to observe the surface ornamentation above mentioned on any of the species here referred to *Cyathus*.

Cythus kellumi, n. sp. Plate 13, figs. 1a, b; 2a, b

Carapace very small, semi-ovate in lateral view, obese; greatest length median; greatest height and thickness near the middle; dorsal margin long, straight, hinge line depressed; anterior (?) end rather narrowly rounded, tending to be somewhat angulated in two places, cardinal angle very obtuse; posterior (?) end more broadly rounded but with a sharp indentation near the hinge line causing a sharp 90° cardinal angle; ventral margin gently convex; outline subovate in dorsal view; surface smooth to finely granulose. Length, .39 mm.; height, .195 mm.; thickness, .23 mm.

Holotype.—Indiana University Paleontological Collections No. 2022.

Hoxbar formation, Crinerville limestone, Pleasant Hills syncline, locality 9, about four miles south and three miles west of Ardmore, Oklahoma.

At another locality, but probably the same horizon a form was found which is quite similar to the one described above. It differs in being centrally more obese and in having a slight elevation on the dorsum just anterior(?) to the posterior(?) cardinal angle. Pending further study this form is included with *Cyathus kellumi*, n. sp. Length, .43 mm.; height, .21 mm.; thickness, .25 mm.

Paratype.—Indiana University Paleontological Collections No. 2132. (Plate 13, figs. 2a, b).

Hoxbar formation, locality 22, Union Dairy limestone, two and one-half miles south of Ardmore, Oklahoma.

This species is named for Dr. Lewis B. Kellum, University of Michigan.

Cyathus ? marginata, n. sp. Plate 13, figs. 3a, b

Carapace very small, semi-ovate in lateral view; greatest length median; greatest height near the middle; greatest thickness about one-third the length from the posterior end; dorsal margin and hinge line straight; anterior margin blunt, square, truncate dorsally and ventrally, cardinal angle very obtuse; posterior margin broadly rounded, cardinal angle obtuse but distinct; ventral margin slightly convex; posterior margin bordered by a nodiferous ridge; surface smooth. Length, .5 mm.; height, .26 mm.; thickness, .2 mm.

Holotype.—Indiana University Paleontological Collections No. 2172.

Basal Hoxbar, Confederate limestone, locality 47, three miles south of Ardmore, Oklahoma.

Genus ARDMOREA, n. gen.

Genotype *Ardmorea symmetrica,* n. sp.

Carapace small, more or less semicircular in lateral view; dorsal margin straight or arched; hinge line long, straight, depressed; end margins nearly identical, rather broadly curved, merging smoothly into the convex ventral margin, terminating dorsally rather abruptly in the obtuse but distinct cardinal angles; centrally obese, tending to be thin at the edges; valves equal or nearly so; surface smooth.

Ardmorea symmetrica, n. sp. Plate 13, figs. 6a, b

Carapace small, semicircular in lateral view; greatest length slightly above the center; greatest height and thickness central; hinge line long, straight, depressed; cardinal angles obtuse, but distinct; ends appear identical, equally curved, truncate dorsally, but forming a smooth semicircular curve with the ventral margin; canoe-shaped in dorsal aspect, centrally obese, edges thin;

valves apparently equal; surface smooth. Length, .66 mm.; height, .365 mm.; thickness, .18 mm.

Holotype.—Indiana University Paleontological Collections No. 2083.

Deese formation, Devil's Kitchen member, locality 68, seven miles south and one mile east of Ardmore, Oklahoma.

Ardmorea gibberosa (Knight) Plate 13, figs. 4a, b

Aechmina? gibberosa Knight, 1928, Jour. Pal., vol. 2, no. 3, p. 235, pl. 31, figs. 9a, b. (Pawnee limestone, St. Louis County, Missouri.)

Carapace small, subovate to semicircular in lateral view; hinge line long, straight, depressed; dorsal margin arched at the middle, due to strong mid-dorsal inflation of the valves; ends equally, and smoothly rounded; ventral margin convex; greatest length, height, and thickness near the middle; valves apparently equal; surface smooth. Length, .61 mm.; height, .58 mm.; thickness, .36 mm.

Plesiotype.—Indiana University Paleontological Collections No. 2160.

Basal Hoxbar, Confederate limestone, locality 47, three miles south of Ardmore, Oklahoma.

Genus SCHMIDTELLA Ulrich, 1894

Two rather unusual species, which may very questionably be referred to this genus, have been figured. They may be of interest to some readers.

Plate 13, figs. 5a, b. Several specimens, all poorly preserved, have been found in the Pumpkin Creek, locality 144. They will be described when better material is obtained. Measurements of the figured specimen: length, .62 mm.; height, .47 mm.; thickness, .34 mm.

Specimen.—Indiana University Paleontological Collections No. 2035.

Plate 13, figs. 9a, b. This very interesting form appears to be very nearly if not exactly equivalved. It may not be an ostracode, and will not be described until more specimens have been found and studied. From the Lester limestone, locality 145. Length, .365 mm.; height, .365 mm.; thickness, .225 mm.

Specimen.—Indiana University Paleontological Collections No. 2140.

New genus? Plate 13, figs. 8a, b

A single valve, unlike that of any ostracode the writer has seen described, was found in the Otterville limestone, locality 148. The figure is presented in the hope that some one may have similar specimens and describe them. Length, .7 mm.; height, .44 mm.

Specimen.—Indiana University Paleontological Collections No. 2036.

Genus BINODELLA, n. gen.

Genotype *Binodella binoda,* n. sp.

Carapace small, semi-ovate in lateral view; dorsal margin straight; hinge line long, straight; ends equally rounded; ventral margin convex; a prominent node just above the center of each valve; valves apparently equal; surface smooth, finely or coarsely granulose, or finely reticulate.

Several specimens were found in the Deese formation, mostly near the Arnold limestone. Most of the specimens are quite smooth, but the most granulose one, when examined under very high power, showed very fine, indistinct, rather irregular reticulations. All of these specimens are thought to belong to the same species, the surface character being mainly a matter of preservation.

Binodella binoda, n. sp. Plate 13, figs. 7a, b

Carapace small, semi-ovate in lateral view; hinge line long, straight, not depressed; dorsal margin straight; ends equally rounded; ventral margin convex; a prominent node arises just above the center of each valve; valves apparently equal; greatest length median or slightly above; greatest height at the middle; greatest thickness through the nodes; surface very finely and irregularly reticulated. Length, .52 mm.; height, .27 mm.; thickness, .3 mm.

Holotype.—Indiana University Paleontological Collections No. 2115.

Deese formation, locality 105, about 100 feet below the Arnold limestone, one mile north and about one-half mile east of Deese, Oklahoma.

REGISTER OF LOCALITIES

1. Hoxbar formation, Anadarche limestone, soft streaks and shale breaks. Cut on east-west road, NE. cor. sec. 34, T. 5 S., R. 2 E., six miles south and three miles east of Ardmore, Oklahoma.

3. Anadarche limestone, first good ledge above conglomerate, on north-south road where limestone crosses NE. cor. sec, 34, T. 5 S., R. 2 E.

4. Hoxbar, shale east side road, .5 mile south of NW. cor. sec. 26, T. 5 S., R. 2 E. N. side sandstone ledge just above Daube limestone.

5. Sandstone 2 feet above outcrop of Daube limestone, east side of road near SW. cor. sec. 26, T. 5 S., R. 2 E., six miles south and three miles east of Ardmore.

6. Shale just below coal seam in Daube limestone, 10 feet below 5.

7. Shale below Daube limestone, 40 feet horizontally south of 5, west side of road near SW. cor. sec. 27, T. 5 S., R. 2 E.

8. Near horizon of Daube limestone, Westheimer and Daube old mine, CN. 1/2 SE. 1/4 sec. 8, T. 5 S., R. 2 E., two and one-half miles south and 3/4 mile east of Ardmore.

9. Crinerville fusuline horizon, Pleasant Hill syncline, back of barn, east of north-south road, SW. 1/4 sec. 14, T. 5 S., R. 1 E., about three miles west and two and three-quarters miles south of Ardmore.

10. Crinerville below fusuline horizon; about eight feet below sample 9.

11. Westheimer, above conglomerate, P. H. S., Criner Hills, SW., 1/4 sec. 14, T. 5 S., R. 1 E.

12. Union Dairy limestone, road north side of cemetery south edge of Ardmore.

13. Union Dairy limestone, top part, Railroad cut, about CNL. SW. 1/4 sec. 6, T. 5 S., R. 2 E.

14. Union Dairy, shale breaks in lower part, same location as 13.

15. Shale 20 feet below Union Dairy, same location as above.

20. Shale 112-115 feet above conglomerate, near base of Hoxbar, SL. SE. 1/4 SE. 1/4 sec. 22, T. 3 S., R. 2 E., seven miles north and three miles east of Ardmore.

21. Shale upper part highest limestone exposed (Confederate of Tomlinson), CEL. sec. 32, T. 3 S., R. 1 E., about eight miles northwest of Ardmore.

22. Union Dairy limestone, EL. sec. 7, T. 5 S., R. 2 E., two and one-half miles south of Ardmore.

25. Shale about 175 feet above Confederate, 270 feet north along road, EL. sec. 7, T. 5 S., R. 2 E., two and three-quarters miles south of Ardmore.

27. Shale 30 feet above Confederate, above location.

47. Confederate, weathered limestone with abundant *Composita subtilita,* creek bank, near NL. NW. 1/4 NW. 1/4 sec. 17, T. 5 S., R. 2 E., three miles south of Ardmore.

50. Fusuline horizon in, or just below, the Daube limestone, near the CNW. SE. 1/4 NW. 1/4 sec. 35, T. 5 S., R. 2 E., about three-quarters mile west of Hoxbar.

51. Yellow shale at base of Daube limestone on WL. sec. 26, T. 5 S., R. 2 E., east side of road, six miles south and three miles east of Ardmore.

53. Hoxbar, shale 200 feet above upper Westheimer, about CNE. SE. 1/4 SW. 1/4 sec. 27, T. 5 S., R. 2 E., about six miles south and two and one-half miles east of Ardmore.

54. Shale 2 feet below Crinerville (?), about 200 feet above 53, about 200 feet from CEL. SW. 1/4 sec. 27, T. 5 S., R. 2 E.

55. Hoxbar, shale 75 feet above Westheimer, CS. 1/2 NE. 1/4 SW. 1/4 sec. 27, T. 5 S., R. 2 E., six miles south and about two and one-quarter east of Ardmore.

60. Hoxbar shale, 100 feet NW along strike from 55.

61. Shale in gully 250 feet below Westheimer about CEL. NW. 1/4 SW. 1/4 sec. 27, T. 5 S., R. 2 E.

64. Deese, Arnold limestone, fusuline horizon, 47 feet above base in road, EL. NE. 1/4 NE. 1/4 sec. 29, T. 3 S., R. 1 E.

65. Arnold limestone, 35 feet above base in road, above location, about nine miles northwest of Ardmore.

66. Arnold limestone, on main ridge, 10 feet above base, about CS. 1/2 NW. 1/4 sec. 28, T. 3 S., R. 1 E.

67. Arnold limestone, 35 feet above base of heavy ledge, near CS. 1/2 NW. 1/4 NW. ¼ sec. 28, T. 3 S., R. 1 E.

68. Deese, Devil's Kitchen member, shaly horizons in thin-bedded limestone between upper and lower sandstones, NW. cor. sec. 4, T. 6 S., R. 2 E., seven miles south and one mile east of Ardmore, Oklahoma.

69. Devil's Kitchcen, 10 feet of shale with thin limestone streaks below main limestone between the two Devil's Kitchen sandstones, NW. cor. sec. 4, T. 6 S., R. 2 E.

70. Deese(?), shale immediately below base of Confederate(?) .5 mile north of Deese School, CEL. sec. 32, T. 3 S., R. 1 E.

71. Shale 20 feet below above sample.

74. Shale 150 feet below Confederate (?) limestone, about .5 mile north of Deese School, and about eight miles northwest of Ardmore.

77. Shale about 70 feet above chert conglomerate, about .6 mile north of Deese School.

78. Shale just above chert conglomerate, below impure limestone west side of road, .65 mile north of Deese.

79. Shale 30 feet below chert conglomerate, in road, .7 mile north of Deese.

80. Shale 150 feet above chert conglomerate, in gully, about .7 mile north, and .1 mile west of Deese School, near the CNE. 1/4 NE. 1/4 sec. 32, T. 3 S., R. 1 E.

84. Deese, shale half way between chert conglomerate and first small limestone member below, about 100 feet below chert conglomerate in the CNE. 1/4 NE. 1/4 NE. 1/4 sec. 32, T. 3 S., R. 1 E.

85. Thin-bedded limestone and shale 10 feet below first small

member below chert conglomerate, near CNL. NE. 1/4 NE. 1/4 sec. 32, T. 3 S., R. 1 E.

90. Deese, immediately above small shell conglomerate, 30 feet below top of resistant member, 250 feet east of NW. cor. sec. 33, T. 3 S.

95. Deese, shale near the CNL. NE. 1/4 NW. 1/4 sec. 33, T. 3 S., R. 1 E.

96, 97. Shale 5 feet and 15 feet below sample above.

98. Shale 150 feet below 95 and 220 feet above Arnold limestone, near the NE. cor. NW. 1/4 sec. 33, T. 3 S., R. 1 E., one mile north and one-half mile east of Deese.

103. Shale 50 feet below Arnold limestone, 600 feet south of road in gully, NW. 1/4 NE. 1/4 sec. 33, T. 3 S., R. 1 E.

104. Shale 100 feet below Arnold limestone, 500 feet south of road in gully, location as above.

105. Shale 2 feet below above.

106. Shale 400 feet below Arnold limestone, 200 feet south of road, about CN. 1/2 NW. 1/4 NE. 1/4 sec. 33, T. 3 S., R. 1 E.

108. Shale east side of creek, 150 feet below sample above.

115. Dornick Hills, shale in creek, directly north of house, SW. 1/4 SW. 1/4 sec. 27, T. 3 S., R. 1 E.

116. Dornick Hills, shale in Otterville, 150 feet downstream, and about 25 feet lower stratigraphically than 115, NE. 1/4 SW. 1/4 SW. 1/4 sec. 27, T. 3 S., R. 1 E.

117. Shale 20 feet stratigraphically below Otterville, downstream, same location as above.

119. Dornick Hills-Springer contact(?), shale 50 feet below 117, about 150 feet down-stream (northeast) from that location.

126. Shale above and below fossiliferous member in road, about 150 feet north of one-half mile fence, EL. sec. 18, T. 5 S., R. 2 E., three and one-half miles north of Ardmore.

144. Dornick Hills, Pumpkin Creek, heavy ledge east, above Lester limestone, SL. sec. 20, T. 3 S., R. 2 E., seven miles north of Ardmore.

145. Dornick Hills, Lester limestone, SWC. sec. 20, T. 3 S., R. 2 E., seven miles north of Ardmore.

146. Otterville limestone, upper part, east side of road, NWC. sec. 5, T. 6 S., R. 2 E., about seven miles south of Ardmore.

147. Otterville limestone, lower part, location as above.

148. Otterville limestone, near middle, in road, NEC. sec. 19, T. 3 S., R. 2 E., eight miles north of Ardmore.

149. Jolliff limestone, shale breaks, east side of road, about CWL. sec. 19, T. 3 S., R. 2 E., main highway, seven and one-half miles north of Ardmore.

150. Dornick Hills formation, Pumpkin Creek (?), shale breaks in lower part, .35 mile N. of SL. of sec. 11, T. 4 S., R. 1 E., on road one-quarter mile west of the east line.

152. Shale between Lester and Otterville, 40 feet below sandstone ledge above .55 mile north of SL. sec. 11, T. 4 S., R. 1 E., on road one-quarter mile west of the east line.

154. Otterville, shale breaks, .85 mile north from SL. sec. 11, T. 4 S., R. 1 E., on road as above.

155. Shale about 250-260 feet horizontally north from 154, half way between Otterville and top of Springer, .9 mile north from SL. sec. 11, T. 4 S., R. 1 E., in road one-quarter mile west of east section line.

156. Black shale near Dornick Hills-Springer contact, 15 feet south of corner post east side of road, NL. sec. 11, location above.

157. 158, 159. Springer, shale east side of road, 20 feet, 35 feet, 40 feet north of SL. of SE. 1/4 sec. 2, T. 4 S., R. 1 E.

160. Dornick Hills, shale break in Jolliff (?), at least in small fossiliferous ls. about 200 feet below Otterville, about 100 yards south of the NL. sec. 12, T. 3 S., R. 2 E., main gully in NE. 1/4.

161. Shale 50 feet below Otterville, gully NE. 1/4 sec. 12, T. 3 S., R. 2 E.

162. Shale, one foot below Otterville, 3 feet below 163.

163. Otterville, shale breaks, main gully, 200 yards south of NL. and one-quarter mile west from EL. sec. 12, T. 3 S., R.

2 E., two miles northwest of Berwyn, and ten miles north and four and three-quarters miles east of Ardmore.

164. Otterville, on east bank of stream, one-quarter mile east from NWC. sec. 11, T. 3 S., R. 2 E.

165. Otterville, 30 feet east of 164.

166. Shale 300 feet above Otterville, in gully 100 feet due north of privy, about 400 feet southeast of 165.

167. Shale above sandstone bed 15 feet above Pumpkin Creek (?), west bank of creek west of house, about 300 feet higher in section than 166.

168. Springer, shale above Primrose, and about same horizon as 176, .2 mile north and one-quarter mile west of SE. cor. sec. 2, T. 4 S., R. 1 E.

169. Springer, shale above Primrose, .3 mile north and one-quarter mile west of SEC. sec. 2, T. 4 S., R. 1 E.

170. Springer, .05 mile north last sample, about 200 feet above Primrose.

174. Springer, immediately above overbrook sandstone, .4 mile north and .3 mile west of SEC. sec. 12, T. 4 S., R. 1 E.

175. Springer, shale in Rod Club member, Caddo anticline, main highway, EL. sec. 12, T. 4 S., R. 1 E.

176. Springer, shale between Jolliff limestone and Primrose sandstone, Caddo Creek, 400 feet east of SW. cor. sec. 31, T. 3 S., R. 2 E.

PLATES

PLATE I

EXPLANATION OF PLATE 1

Figure		Page
1.	**Paraparchites wapanuckensis** Harlton, x 55, right side	30
2.	**Paraparchites ottervillicus,** n. sp., x 55, right side	30
3.	**Paraparchites elongatus,** n. sp., x 27, right side	32
4.	**Paraparchites guthreyi,** n. sp., x 55, left valve	31
5.	**Paraparchites dornickhillicus,** n. sp., x 27, left side	31
6.	**Paraparchites,** n. sp., x 27, right side	33
7.	**Paraparchites ardmorensis,** n. sp., x 55. **a,** left side; **b,** dorsal view.	34
8.	**Paraparchites brazoensis** Coryell and Sample, x 55.	32
9.	**Paraparchites harltoni,** n. sp., x 27 **a,** left side; **b,** dorsal view.	33
10.	**Parachites** ? sp. undet. x 27, side view	34
11.	**Coryellina capax,** n. gen. et sp., x 39 **a,** right side; **b,** dorsal view; **c,** ventral view; **c,** posterior end.	36
12,13.	**Monoceratina ventralis** Roth, x 27 12, right valve; **13a,** right valve, another specimen; **13b,** dorsal view.	75
14.	**Monoceratina dornickhillica,** n. sp., x 27 **a,** right valve; **b,** dorsal view.	76
15,19.	**Monoceratina huddlei,** n. sp., x 27, right valves of a large and a small specimen.	77
16-18.	**Monoceratina,** sp. 16, 17, left valves x 27; 18, a left valve x 55.	77
20.	**Monoceratina,** n. sp., x 39, right valve.	77
21.	**Mammoides mammillata,** n. gen. et sp., x 39, left valve.	37

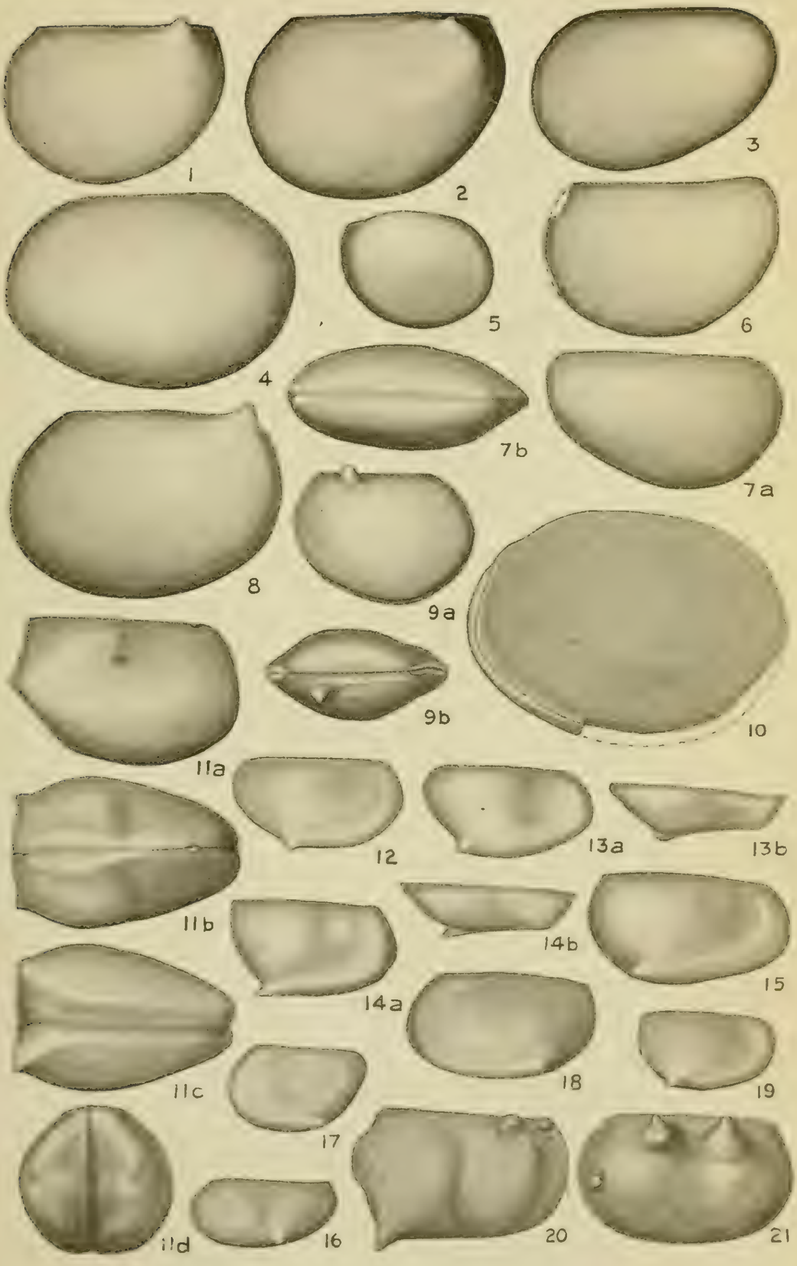

1
2
3
4
5
6
7b
7a
8
9a
9b
10
11a
12
13a
13b
11b
14b
15
14a
11c
18
19
17
11d
16
20
21

PLATE II

EXPLANATION OF PLATE 2

Figure		Page
1.	**Hollinella gibbosa** Kellett, right valve, x 27	47
2,3.	**Hollinella** cf. **pulchra** (Moore), x 27 2, right side; 3, right side.	48
4.	**Hollinella ulrichi** Kellett, x 27, right valve.	48
5.	**Hollites** ? sp., x 39 **a**, left ? valve; **b**, dorsal view.	49
6,7.	**Jonesina arcuata** (Bean), x 39 6, left valve; 7, dorsal view of another specimen.	38
8.	**Jonesina gallowayi,** n. sp., x 55 **a**, left side; **b**, dorsal view.	39
9,11.	**Jonesina biformis**, n. sp. x 55 **9a**, left side; **9b**, dorsal view; **11a**, left side; **11b**, dorsal view.	40
10.	**Jonesina hoxbarana,** n. sp., x 27 **a**, left side; **b**, dorsal view.	40
12.	**Jonesina gregaria** (Ulrich and Bassler), x 27 **a**, left side; **b**, dorsal view.	42
13.	**Jonesina daubeana,** n. sp., x 55 **a**, left side; **b**, dorsal view.	41
14.	**Jonesina deesensis,** n. sp., x 27 **a**, left side; **b**, dorsal view.	42
15-17.	**Jonesina trisulcata**, n. sp., 15, left side, female ?, x 55. **17a**, left side same specimen, x 27; dorsal view x 27. **16a**, left side, male ?; **16b**, dorsal view, x 55.	43

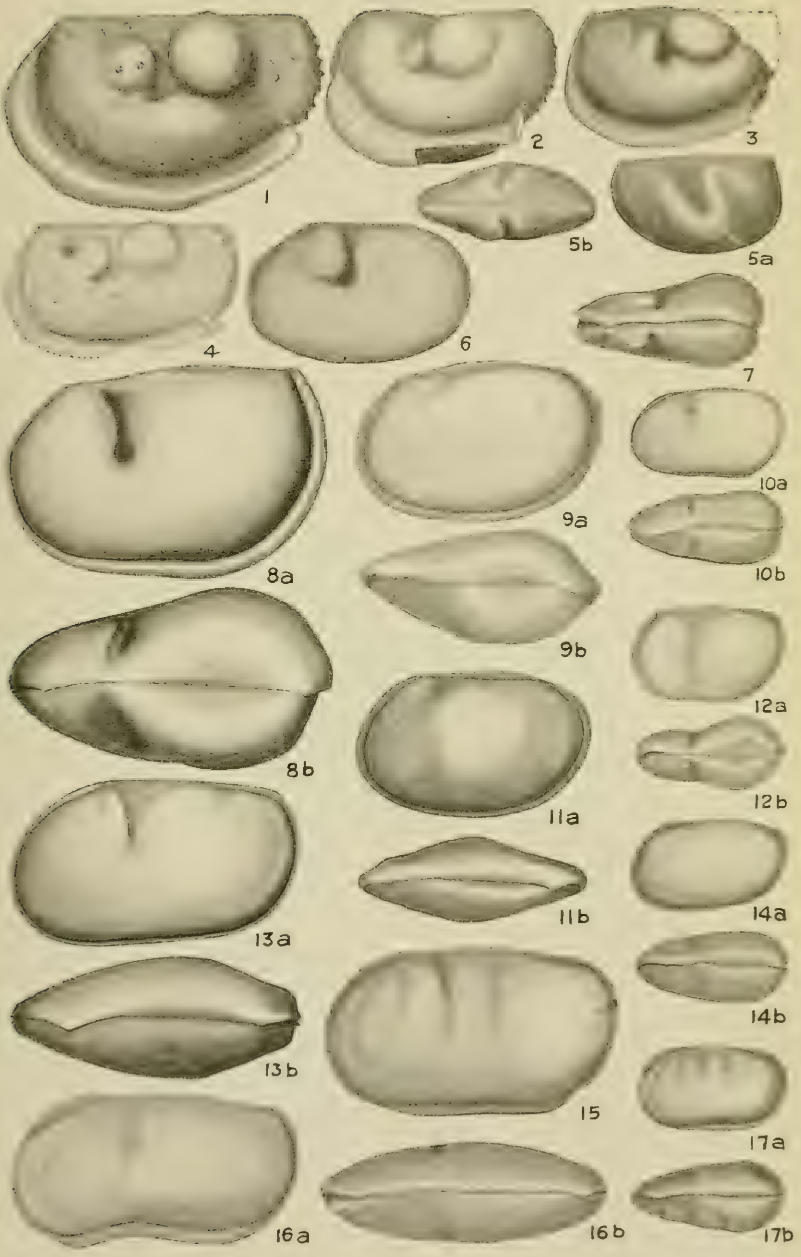
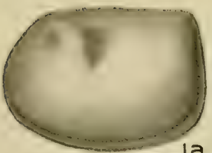
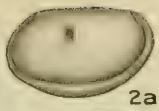

1
2
3
5b
5a
4
6
7
8a
9a
10a
10b
9b
8b
12a
12b
11a
13a
11b
14a
14b
13b
15
17a
16a
16b
17b

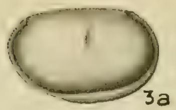
PLATE III

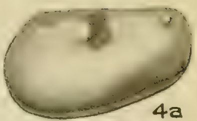
EXPLANATION OF PLATE 3

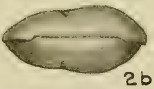
Figure		Page
1.	**Jonesina dubia**, n. sp., x 55 **a**, left side; **b**, dorsal view.	43
2.	**Sansabella whitei** n. sp., x 27 **a**, left side; **b**, dorsal view.	44
3.	**Kirkbyina laevis** Warthin, x 27 **a**, right side; **b**, dorsal view.	45
4.	**Nuferella infrequens**, n. gen. et sp., x 55 **a**, left side; **b**, dorsal view.	46
5.	**Kirkbya bendensis** Harlton, right valve, x 27	50
6.	**Kirkbya jolliffana**, n. sp., left valve, x 39	51
7.	**Kirkbya**, n. sp., left valve, x 55	53
8.	**Kirkbya obliqua**, n. sp., left valve, x 39.	51
9.	**Ulrichia montosa** Knight, right side, x 55 Plesiotype, No. 2060.	53
10.	**Kirkbya** cf. **inornata** Roth, right valve, x 55	52
11.	**Ulrichia montosa** Knight, Plesiotype, No. 2063, x 39 **a**, right side; **b**, dorsal view; **c**, ventral view.	53
12.	**Amphissites rugosus** Girty, left valve, x 55	54
13.	**Amphissites cumingsi**, n. sp., left valve, x 55	56
14.	**Amphissites marginiferus** Roth, left valve, x 55	55

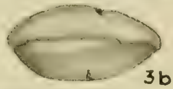

1a

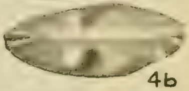

2a

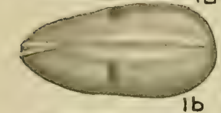

3a

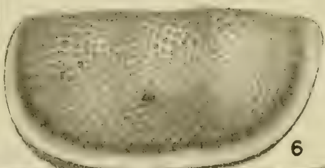

4a

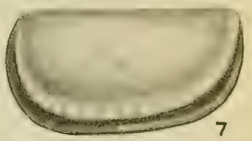

2b

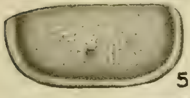

3b

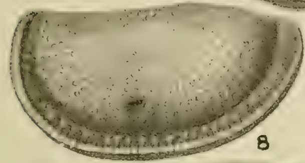

4b

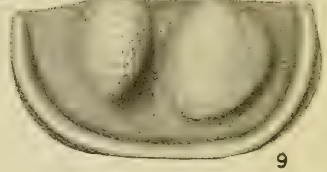

1b

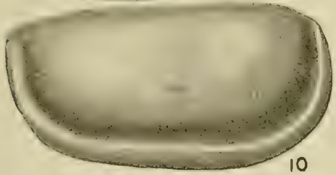

6

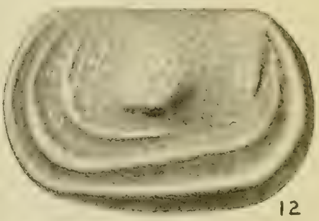

7

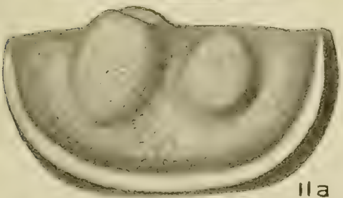

5

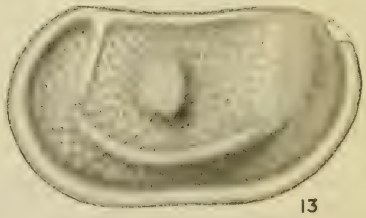

8

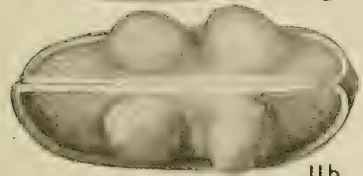

9

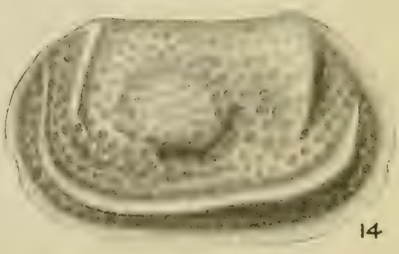

10


12


11a


13


11b


14

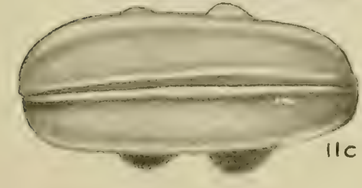
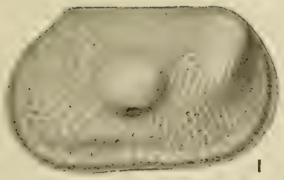
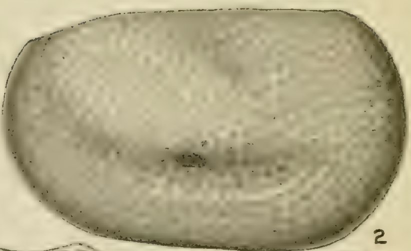

11c

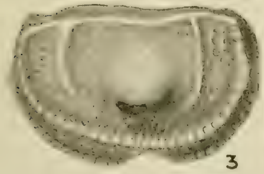
PLATE IV

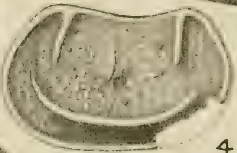
EXPLANATION OF PLATE 4

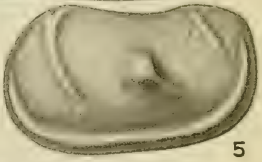
Figure		Page
1.	**Amphissites rothi**, n. sp., left valve, x 39	57
2.	**Amphissites confluens**, n. sp., right valve, x 55	58
3.	**Amphissites contronotus** (Ulrich and Bassler), right valve, x 39	59
4.	**Amphissites alticostatus**, n. sp., left valve, x 55	58
5.	**Amphissites girtyi**, var. **deesensis**, n. var., right valve, x 39	61
6.	**Amphissites pinguis** (Ulrich and Bassler), left valve, x 55	61
7.	**Amphissites edsoni**, n. sp., left valve, x 55	62
8.	**Knightina texana** (Harlton), left side, x 55	64
9.	**Amphissites dattonensis** Harlton, x 39 **a**, left side; **b**, dorsal view; **c**, ventral view.	63
10.	**Knightina kellettae**, n. sp., left valve, x 55	65
11.	**Roundyella bellatula**, n. gen. et sp., left valve, x 55	66
12.	**Scaberina nodomarginata**, n. gen. et sp., x 55 **a**, side view; **b**, interior of valve.	67
13.	**Glyptopleura whitei**, n. sp., right valve, x 27	68
14.	**Youngiella ? elongata** Coryell and Sample, left valve, x 55	72
15.	**Youngiella ? gracilis**, n. sp., x 55 **a**, right side; **b**, dorsal view.	72
16.	**Youngiella ? convergens**, n. sp., x 55 **a**, right side; **b**, dorsal view.	72


1

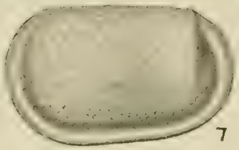

2

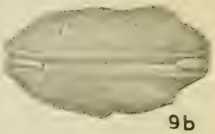

3

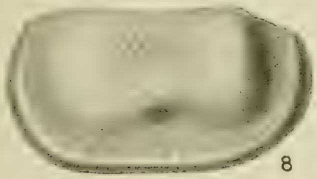

4

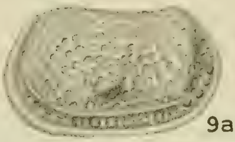

5

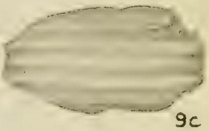
6

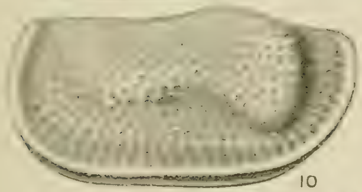

7


9b

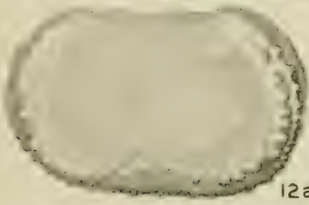

8

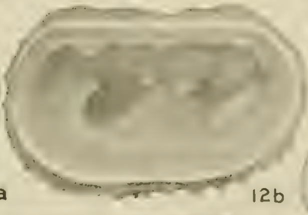

9a

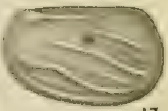

9c


10

11


12a


12b


13

16a

14

15a

15b

16b

PLATE V

EXPLANATION OF PLATE 5

Figure		Page
1.	**Moorites minutus** (Warthin), x 39 **a**, right side; **b**, dorsal view.	73
2.	**Bairdia citriformis** Knight, x 27 **a**, right side; **b**, dorsal view.	78
3.	**Bairdia dornickhillensis** Harlton, x 27 **a**, right side, **b**, dorsal view.	78
4.	**Bairdia hispida**, var. **lesterica**, n. var., x 27 **a**, right side; **b**, dorsal view.	88
5.	**Bairdia biacuta**, n. sp., x 55 **a**, right side; **b**, dorsal view.	79
6.	**Bairdia bidorsalis**, n sp., x 27, **a**, right side; **b**, dorsal view.	81
7.	**Bairdia punctata**, n. sp., x 27 **a**, right side; **b**, dorsal view.	79
8.	**Bairdia crassa** Harlton, x 27 **a**, right side; **b**, dorsal view.	80
9.	**Bairdia oklahomaensis** Harlton, x 27 **a**, right side; **b**, dorsal view.	85
10.	**Bairdia whitesidei**, n. sp. x 27 **a**, right side; **b**, dorsal view.	82
11.	**Bairdia warthini**, n. sp., x 27 **a**, right side; **b**, dorsal view.	83
12.	**Bairdia glennensis** Harlton ?, x 27 **a**, right side; **b**, dorsal view.	81

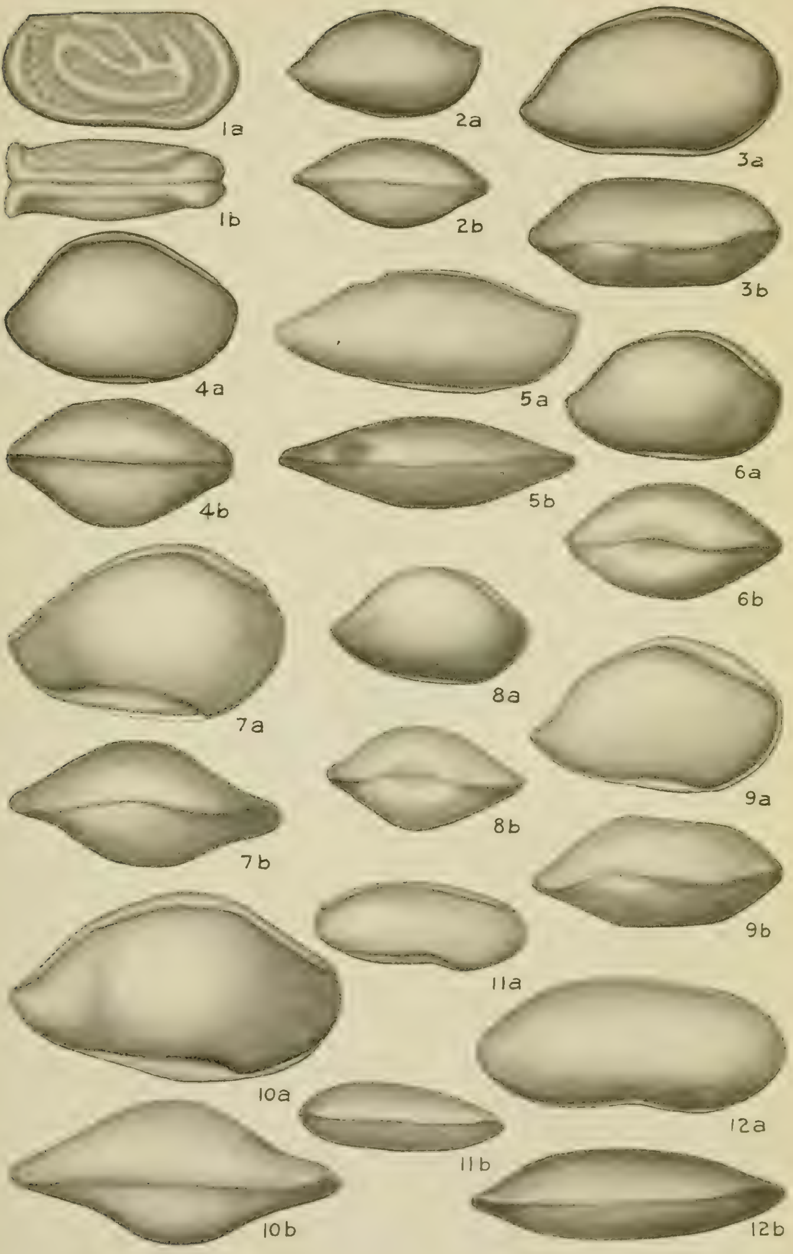
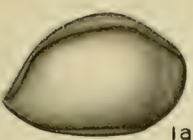
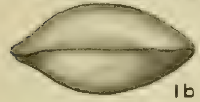

1a
1b
2a
2b
3a
3b
4a
4b
5a
5b
6a
6b
7a
7b
8a
8b
9a
9b
10a
10b
11a
11b
12a
12b

PLATE VI

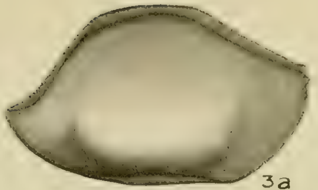
EXPLANATION OF PLATE 6

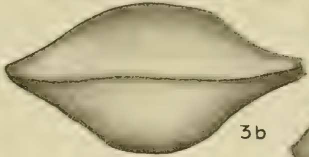
Figure		Page
1.	**Bairdia blakei** Harlton, x 27 a, right side; b, dorsal view.	84
2.	**Bairdia blakei** Harlton, x 27 Left valve of a larger specimen, locality 13.	84
3.	**Bairdia bicornis,** n. sp., x 27 a, right side; b, dorsal view.	84
4, 5.	**Bairdia menardensis** Harlton?, x 27, right valves	85
6.	**Bairdia hispida,** var. **alta,** n. var., x 55 a, left side; b, dorsal view.	88
7.	**Bairdia** n. sp., x 27, locality 162 a, right side; b, dorsal view.	
8.	**Bairdia hoxbarensis** Harlton, x 27, right valve	86
9.	**Bairdia menardvillensis** Harl., x 27, rt. vlv. See under menardensis	85
10.	**Bairdia lunata,** n. sp., x 27, right side	90
11.	**Bairdia longirostris,** n. sp., x 27 a, right side; b, dorsal view.	89
12.	**Bairdia amygdaliformis,** n. sp., x 39 a, right side; b, dorsal view.	89
13.	**Bairdia auricula** Knight, x 27 a, right side; b, dorsal view.	89
14.	**Bairdia ignota,** n. sp., x 27, right side	91
15.	**Bairdia pompilioides** Harlton, x 27 a, right side; b, dorsal view.	87


1a


1b

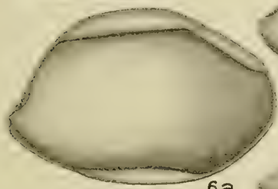
2

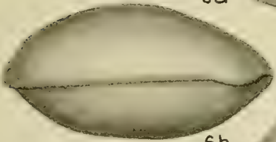

3a

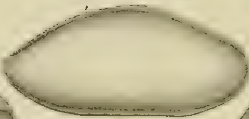

3b

4

5

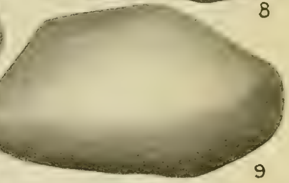

6a


6b

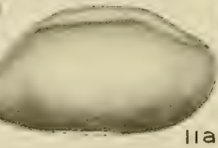

7a

7b

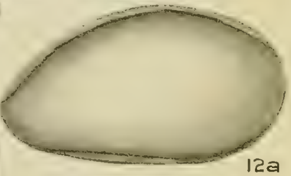
8

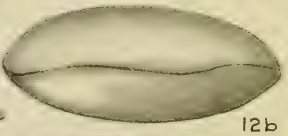

9

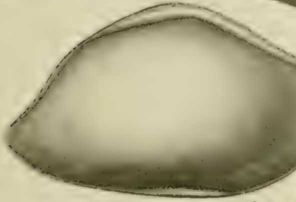
10

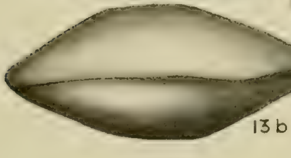

11a

11b

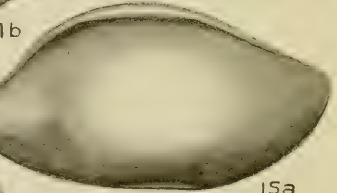

12a


12b


13a


13 b

14


15a

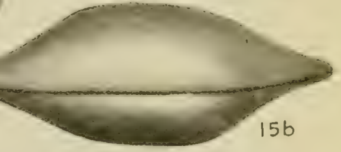
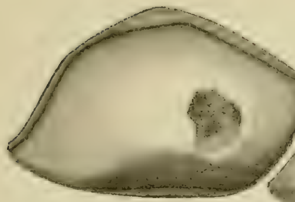

15b

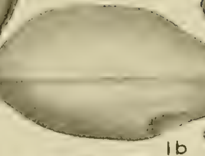
PLATE VII

EXPLANATION OF PLATE 7

Figure		Page
1, 6.	**Bairdia ciscoensis** Harlton? x 27 Ontogenetic series. **a**, views from the right side; **b**, dorsal views.	91
7.	**Bairdia** cf. **ardmorensis** Harlton, x 55 **a**, right side; **b**, dorsal view.	92
8.	**Bairdiacypris deloi,** n. gen. et sp., x 27 **a**, right side; **b**, dorsal view (holotype).	93
9.	**Bairdiacypris** cf. **deloi,** n. sp., x 27 **a**, right side; **b**, dorsal view.	93
10.	**Bythocypris simillima,** n. sp., x 55 **a**, right side; **b**, dorsal view.	96
11.	**Bythocypris tomlinsoni** Harlton, x 55 **a**, right side; **b**, dorsal view.	94
12.	**Bythocypris deesensis,** n. sp., x 55 **a**, right side; **b**, dorsal view.	95
13.	**Bythocypris sasakwaensis** Warthin, x 27, right side	96
14.	**Bythocypris angularis,** n. sp., x 55 **a**, right side; **b**, dorsal view.	97

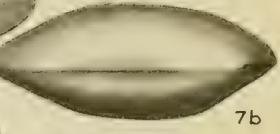


1a

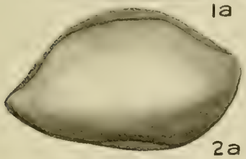


1b

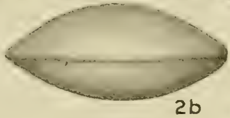
7a



7b

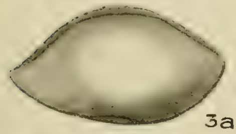


2a

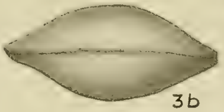


2b

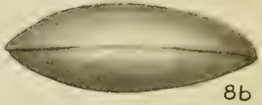
8a



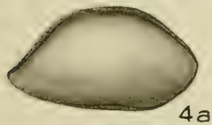
3a



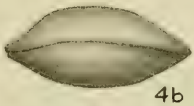
3b



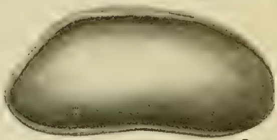
8b



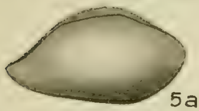
4a



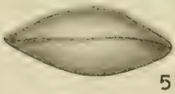
4b



9a

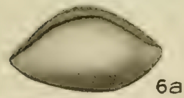


5a

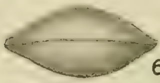


5b

9b

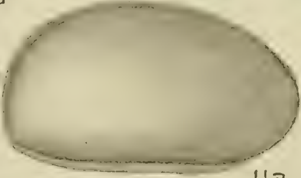


6a



6b

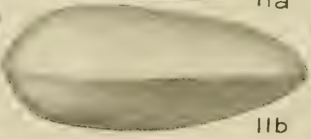
10a



11a

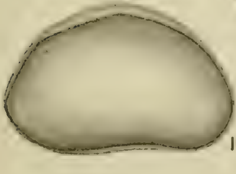
12a

10b

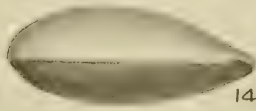


11b

12b



13



14b

14a

PLATE VIII

EXPLANATION OF PLATE 8

Figure Page

1. **Bythocypris cooki**, n. sp., x 55 97
a, right side; b, dorsal view.

2. **Bythocypris scapha** Coryell and Sample, x 55 98
a, right side; b, dorsal view.

3. **Bythocypris irregularis**, n. sp., x 55 99
a, right side; b, dorsal view.

4. **Bythocypris parallela** Knight, x 55 95
a, right side; b, dorsal view.

5. **Bythocypris frivola**, n. sp., x 55 99
a, right side; b, dorsal view.

6. **Bythocypris pediformis** Knight, x 55 100
a, right side; b, dorsal view.

7. **Bythocypris subreniformis**, n. sp., x 55 100
a, right side; b, dorsal view.

8. **Bythocypris hoxbarana**, n. sp., x 55 101
a, right side; b, dorsal view.

9. **Bythocypris subpediformis**, n. sp., x 55 102
a, right side; b, dorsal view.

10. **Bythocypris mytiliformis**, n. sp., x 55 102
a, right side; b, dorsal view.

11. **Waylandella deesensis**, n. sp., x 55 104
a, right side; b, dorsal view.

12. **Macrocypris delicatula**, n. sp., x 55 104
a, right side; b, left side; c, dorsal view, anterior to right; d, ventral view, anterior to right.

13. **Healdiacypris perplexa**, n. gen. et sp., x 55 103
a, right side; b, dorsal view.

14. **Healdia caneyensis** Harlton, x 27, right side 105

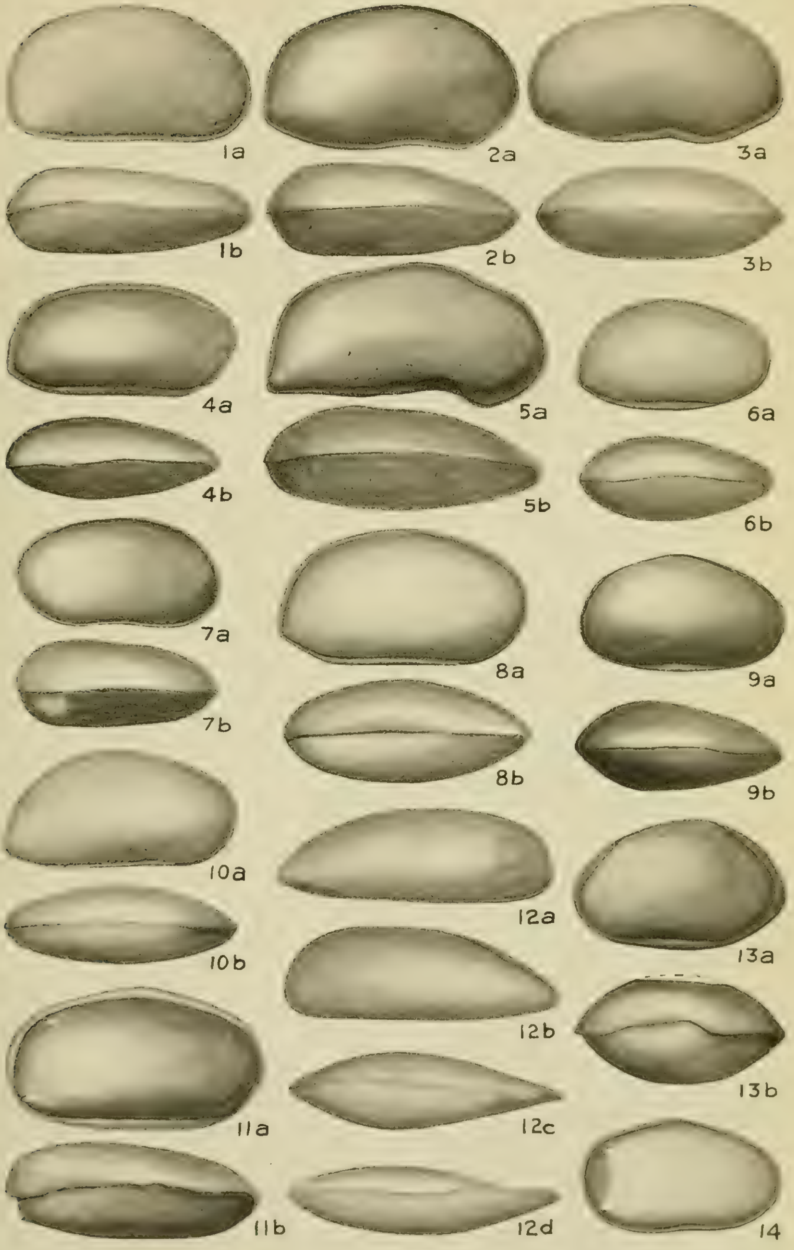

1a
2a
3a
1b
2b
3b
4a
5a
6a
4b
5b
6b
7a
8a
9a
7b
8b
9b
10a
12a
13a
10b
12b
13b
11a
12c
11b
12d
14

PLATE IX

EXPLANATION OF PLATE 9

Figure		Page
1,2.	**Healdia** cf. **ampla** Roundy, x 55 1, a right valve; 2, a left valve.	105
3.	**Healdia bendana,** n. sp., x 55 a, right side; **b,** dorsal view.	107
4.	**Healdia oblonga,** n. sp., x 55 a, right side; **b,** dorsal view.	106
5.	**Healdia arca,** n. sp., x 55 a, right side; **b,** dorsal view.	109
6,7,8.	**Healdia,** sp., x 27 6, left valve, No. 2116; 7, right valve, No. 2112; 8, left valve, No. 2113.	106
9.	**Healdia** cf. **bythocyproidea** Warthin, x 55 a, right side; **b,** dorsal view.	107
10.	**Healdia formosa** Harlton, x 39, left valve	108
11.	**Healdia ehlersi,** n. sp., x 55 a, right side; **b,** dorsal view.	109
12,13.	**Healdia angulata,** n. sp., x 27 12a, right side (holotype); 12**b,** dorsal view; 13, right side.	110
14.	**Healdia bovicornis,** n. sp., x 39, right side	108
15.	**Healdia deesensis,** n. sp., x 39, right valve	108
16.	**Healdia cara,** n. sp., x 55	110
17,18.	**Healdia** cf. **glennensis** Harlton, x 27 17, No. 2108, **a,** right side; **b,** dorsal view; 18, right side No. 2109.	111
19.	**Healdia humilis,** n. sp., x 55 a, right side; **b,** dorsal view.	112
20.	**Healdia ciscoensis** Harlton, x 55 a, right side; **b,** dorsal view.	113

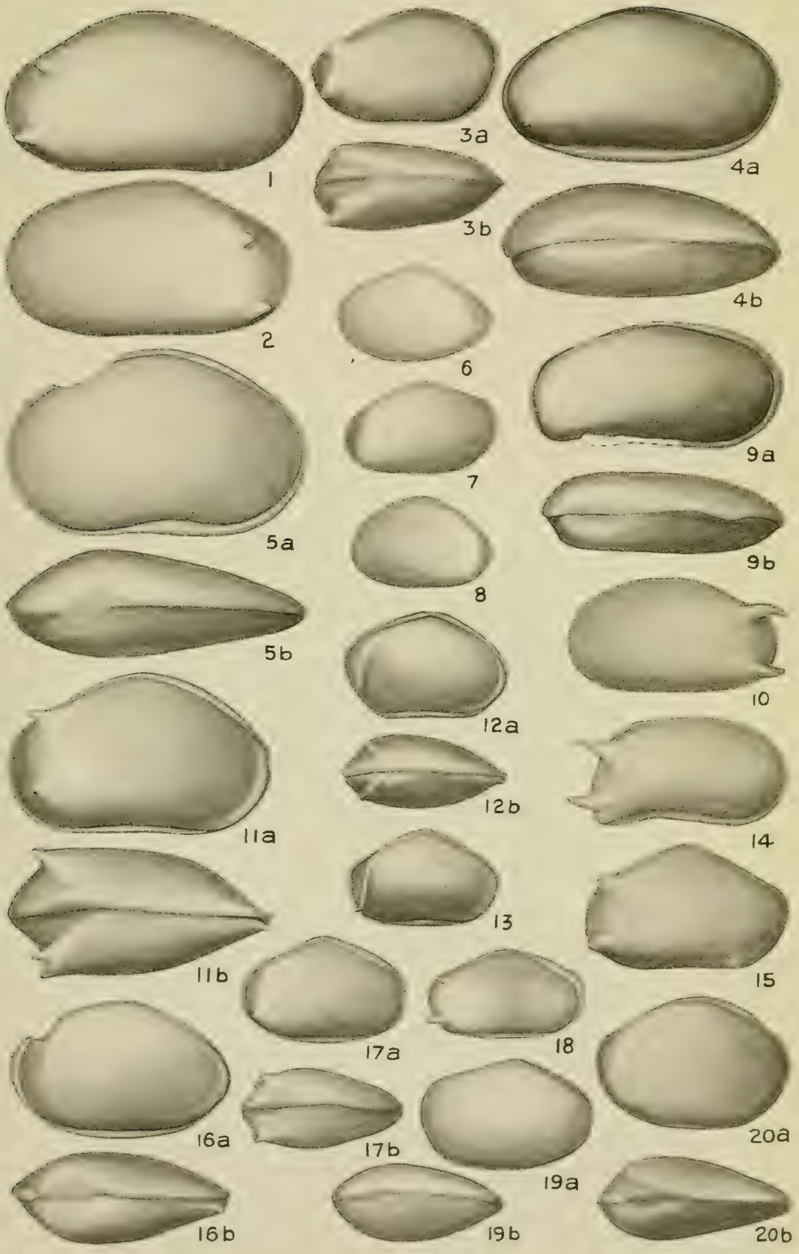

1
3a
4a
3b
2
4b
6
9a
7
5a
9b
8
5b
10
12a
12b
11a
14
13
11b
15
17a
18
16a
17b
20a
19a
16b
19b
20b

PLATE X

EXPLANATION OF PLATE 10

Figure		Page
1.	**Healdia simplex** Roundy, x 55 **a**, right side; **b**, dorsal view.	113
2.	**Healdia cuneiformis**, n. sp., x 55 **a**, right side; **b**, dorsal view.	113
3.	**Healdia alba** Coryell and Billings, x 55 **a**, right side; **b**, dorsal view.	115
4.	**Healdia ovata**, n. sp., x 55 **a**, right side; **b**, dorsal view.	114
5.	**Healdia nucleolata** Knight, x 55 **a**, right side; **b**, dorsal view.	114
6.	**Healdia carterensis**, n. sp., x 55 **a**, right side; **b**, dorsal view.	111
7.	**Seminolites** aff. **elongatus** Coryell, x 39 **a**, right side; **b**, dorsal view.	116
8.	**Semilolites healdoides**, n. sp., x 55, right side	117
9.	**Seminolites** aff. **truncatus** Coryell, x 55, right side	116
10.	**Seminolites ? pushmatahensis** Harlton, x 55, right side	118
11.	**Seminolites kosomensis** Harlton, x 55, right valve	117
12.	**Harltonella ardmorensis**, n. gen. et sp., x 55, right side	119
13.	**Harltonella elongata**, n. sp., x 55, left valve	120
14.	**Harltonella macropleura**, n. sp., x 55, right valve	120
15.	**Harltonella robusta**, n. sp., x 55, left valve	120
16.	**Cytherella jolliffana**, n. sp., x 27 **a**, left side; **b**, dorsal view.	122
17.	**Cytherella berwynensis**, n, sp., x 27 **a**, left side; **b**, dorsal view.	122
18.	**Cytherella ottervillica** var. **obesa**, n. sp., x 27 **a**, left side; **b**, dorsal view.	123

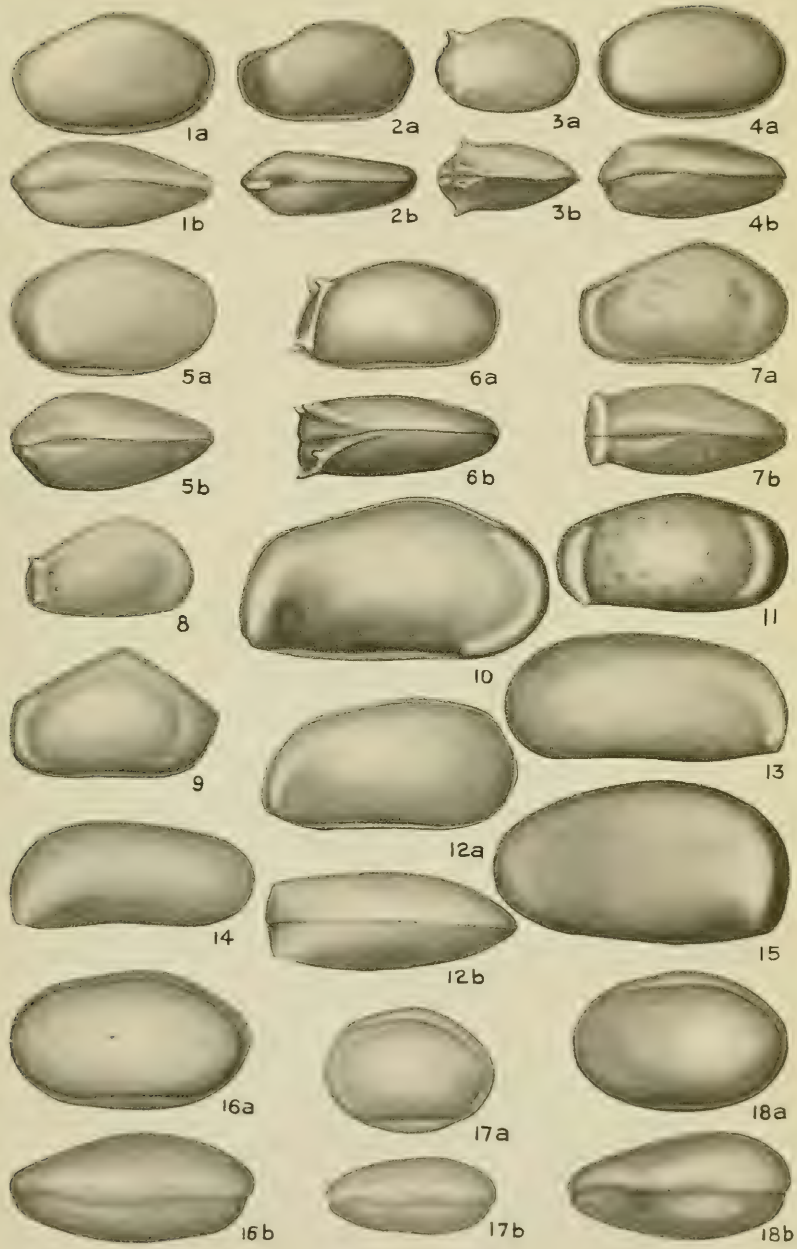

1a
2a
3a
4a
1b
2b
3b
4b
5a
6a
7a
5b
6b
7b
8
10
11
9
13
12a
14
15
12b
16a
17a
18a
16b
17b
18b

PLATE XI

EXPLANATION OF PLATE 11

Figure		Page
1.	**Cytherella ottervillica**, n. sp., x 27 **a**, left side; **b**, dorsal view.	123
2.	**Cytherella ? brevisulcata**, n. sp., x 27 **a**, left side; **b**, dorsal view.	123
3.	**Cytherella cavellinoides**, n. sp., x 27 **a**, left side; **b**, dorsal view.	124
4.	**Cytherella brevis**, n. sp., x 27 **a**, right side; **b**, left side.	124
5.	**Cytherella laevis**, n. sp., x 27 **a**, left side; **b**, dorsal view.	125
6.	**Cytherella lirata**, n. sp., x 27 **a**, left side; **b**, dorsal view.	125
7,10-15.	**Cytherella** aff. **gloria**, n. sp., x 27 7a, left side; **b**, dorsal view; 10-15, ontogenetic series.	126
8.	**Cytherella daubeana**, n. sp., x 27 **a**, left side; **b**, dorsal view.	126
9.	**Cytherella tongia** Coryell and Sample, x 27 **a**, left side; **b**, dorsal view.	128
16,17.	**Cavellina minuta**, n. sp., x 55 16a, left side; **b**, dorsal view; 17, dorsal view of another specimen.	130
18.	**Cavellina robusta**, n. sp., x 27 **a**, left side; **b**, dorsal view.	129
19.	**Cytherella** aff. **gloria** var. **alta**, n. var., x 27 **a**, left side; **b**, dorsal view.	128
20.	**Cavellina subpulchella**, n. sp., x 27 **a**, right side; **b**, dorsal view.	129

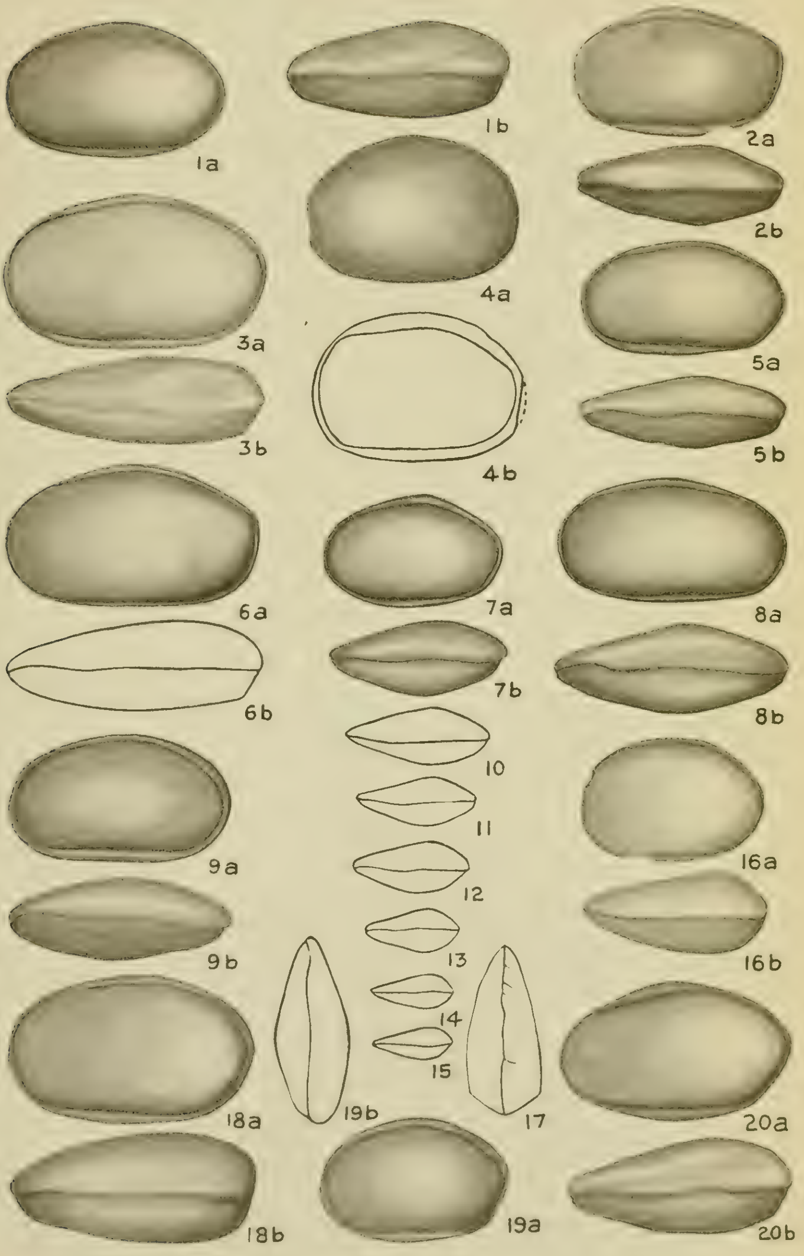
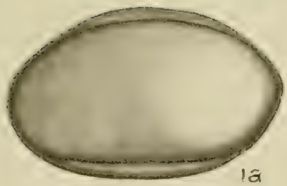
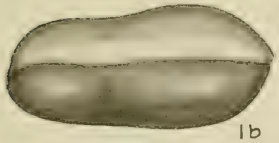

1a
1b
2a
2b
3a
3b
4a
4b
5a
5b
6a
6b
7a
7b
8a
8b
9a
9b
10
11
12
13
14
15
16a
16b
17
18a
18b
19a
19b
20a
20b

PLATE XII

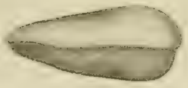
Explanation of Plate 12

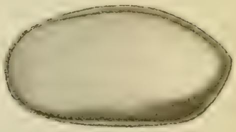
Figure		Page
1.	**Cavellina ? bisecta,** n. sp., x 55 **a,** left side; **b,** dorsal view.	130
2.	**Cavellina pulchella** Coryell, x 27 **a,** left side; **b,** dorsal view.	131
3.	**Cavellina expansa,** n. sp., x 27 **a,** left side; **b,** dorsal view.	132
4.	**Cavellina polita,** n. sp., x 27 **a,** left side; **b,** dorsal view.	132
5.	**Cavellina** aff. **pulchella** Coryell, x 27 **a,** left side; **b,** dorsal view.	131
6,7.	**Cavellina laevissima,** n. sp., x 27 6**a,** left side; **b,** dorsal view; 7**a,** a right valve; **b,** interior of same right valve.	133
8.	**Cavellina,** sp., x 27 **a,** a left valve; **b,** dorsal view.	134
9,10.	**Sulcella harrisi,** n. sp., x 27 9, left side; 10**a,** left side, specimen lacerated along dorsal commissure line; 10**b,** dorsal view.	134
11.	**Cavellinella casei,** n. gen. et sp., x 55 **a,** left side; **b,** dorsal view.	136

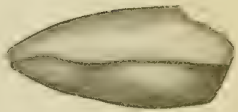

1a

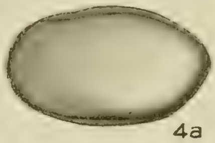

1b

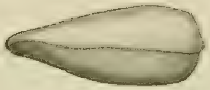
2a

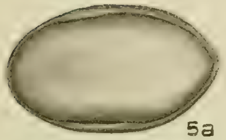

2b

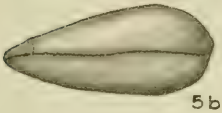

3a

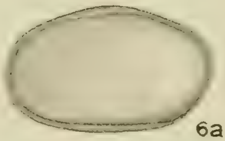

3b

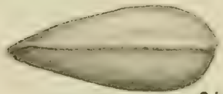

4a


4b

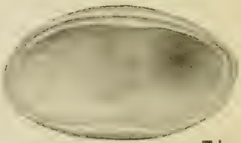

5a

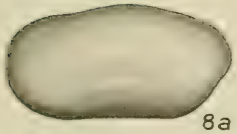

5b

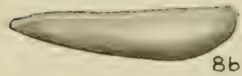

6a

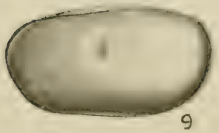

6b

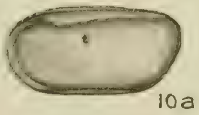
7a

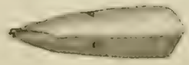

7b

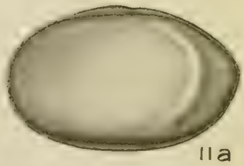

8a


8b


9


10a


10b


11a

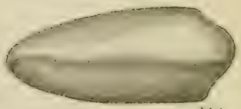

11b

PLATE XIII

EXPLANATION OF PLATE 13

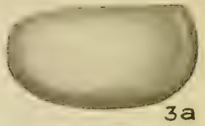
Figure		Page
1.	**Cyathus kellumi,** n. sp., x 55 **a,** left? side; **b,** dorsal view.	137
2.	**Cyathus kellumi?,** n. sp., x 55 **a,** left? side; **b,** dorsal view.	137
3.	**Cyathus? marginata,** n. sp., x 55 **a,** left side; **b,** dorsal view.	138
4.	**Ardmorea gibberosa** (Knight), x 55 **a,** side view; **b,** dorsal view.	139
5.	**Schmidtella?** sp. x 27 **a,** side view; **b,** dorsal view.	139
6.	**Ardmorea symmetrica,** n. gen. et sp., x 55 **a,** side view; **b,** dorsal view.	138
7.	**Binodella binoda,** n. gen. et sp., x 55 **a,** side view; **b,** dorsal view.	140
8.	New Genus ? x 55 **a,** side view single valve; **b,** interior same valve.	140
9.	**Schmidtella** ?? sp., x 55 **a,** side view; **b,** dorsal view.	139

1a

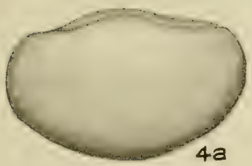
1b

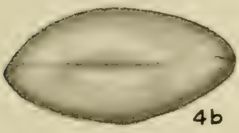
2a

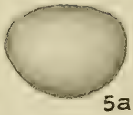
2b

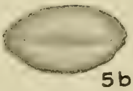

3a

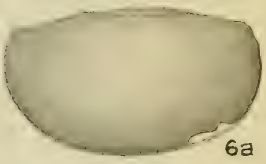
3b

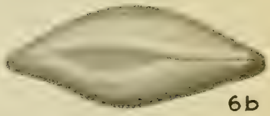

4a

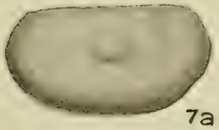

4b

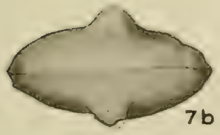

5a


5b


6a

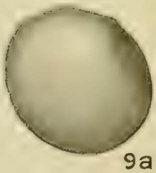

6b

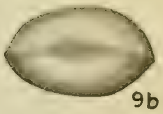

7a


7b

8a

8b


9a


9b

BULLETINS

OF

AMERICAN PALEONTOLOGY

Vol. 22

No. 74

Seven New Species of Foraminifera from the Tertiary of the Gulf Coast

By Wade H. Hadley, Jr.

March 11, 1935

PALEONTOLOGICAL RESEARCH INSTITUTION
FOUNDED 1932

Ithaca, New York,
U. S. A.

SEVEN NEW SPECIES OF FORAMINIFERA FROM THE TERTIARY OF THE GULF COAST

by

WADE H. HADLEY, JR.

Genus GAUDRYINA d'Orbigny, 1839

Gaudryina koimetercola Hadley, n. sp. Plate 1, figs. 1a, b

Test elongate, moderately compressed; periphery broadly rounded; early portion triserial, roughly triangular in cross section, making up about one fourth of the test's total length, remainder of test composed of six or seven pairs of biserially arranged chambers; initial end bluntly pointed, test widens rapidly where the biserial stage begins, from this point to the distal end the sides of the test are nearly parallel; chambers slightly wider than high, not inflated; sutures are flush with the chambers and inconspicuous; wall composed of fine sand grains and a liberal amount of cement, a few sand grains of larger size are scattered irregularly over the test; aperture a low arch located in the center of the distal end and at the base of the last chamber.

Length of holotype.—0.56 mm.

Holotype from Vicksburg Mississippi at the falls nearest the Mississippi River on Glass Bayou, National Park Cemetery in a three foot bed of yellowish gray marl. Louisiana State University Museum Collection No. 769. This species was obtained from some material of Dr. H. V. Howe.

Genus MASSILINA Schlumberger, 1893

Massilina goniopleura Hadley, n. sp. Plate 1, figs. 2a-c

Test of medium size for genus, considerably longer than wide; five chambers exposed by most of the specimens; chambers triangular in cross section, not inflated, well overlapping; periphery acute; sutures smooth, inconspicuous, almost flush with test; test smooth and porcelaneous; aperture at the end of the final chamber which is extended into a moderately long neck; with a small, low simple tooth.

Length of holotype.—1.07 mm.

Holotype from the Moody's Branch Marl on Town Creek, Jackson Mississippi, where it is crossed by the Great Northern Railroad Bridge. Louisiana State University Museum Coll. No. 770.

The majority of specimens referred to this species do not have their final chambers lying in one plane, though many of them closely approach this arrangement. A few specimens however reach the true development that characterize *Massilina*. I believe that all of the above mentioned forms belong to the same species and that it is most practical to describe them under the generic name *Massilina*.

The salient characters of *Massilina goniopleura* are the very sharp periphery and the non-inflated chambers.

Distribution.—Common at the type locality; also occurs in the Moody's Branch Marl at Montgomery on the Red River, at Grandview Bluff on the Ouachita River, at the Belhaven College locality, Jackson, Miss., and from Garland Creek, Clark County, Mississippi; N. W. corner of Sect. 28, 1, N. 16 E.; 2-10 of a mile east of bridge over Garland Creek.

Genus BITUBULOGENERINA Howe, 1934

Bitubulogenerina chickasawhayica Hadley, n. sp. Plate 1, fig. 3

Test small, elongate; triserial portion making up only a small portion of the test; in the biserial portion the chambers become more widely separated along the axis toward the distal end and approach a uniserial development; chambers widest just below their equitorial plane, where they develop a thickened rim in the later chambers and a row of downward pointing tubuli in the earlier ones; separate chambers distinct but the contact between them not sharp; wall calcareous, exterior surface coarsely granular.

There were only two specimens of this species found in the material examined. The aperture is broken off both of them. The aperture of this genus is oval or angular, tending to become siphonate, and usually possessing a distinct lip.

Length of holotype.—0.49 mm.

Holotype from the Lower Chickasawhay Member of the Mississippi Miocene; Approximate location is NW corner of SWNE of section 24, 9 N. 7 W, 4-10 of a mile SE. of road intersection with highway No. 45. Louisiana State Museum Collection No. 772.

Bitubulogenerina vicksburgensis[1] has the periphery of its chambers sharply angled and the tubuli are not downward pointing.

This species is from material of Dr. H. V. Howe of Louisiana State University.

Genus SPIROLOCULINA d'Orbigny, 1826

Spiroloculina bidentata Hadley, n. sp. Plate 1, figs. 4 a, c

Test stout and thick, roundly elliptical in side view, width is about two thirds the height; chambers with thickened, elevated and rounded margins, quadrate in cross section; the contact between adjacent chambers is marked by a prominent ridge which is the thickened margin of a chamber lying out of the plane of coiling; test excavated, being very thin at the center; wall thick and smooth, not typically porcelaneous; aperture at the extreme end of the final chamber which is only slightly elongated, broadly elliptical in outline and with the long axis lying at right angles to the plane of coiling; the aperture bears two simple teeth located toward the inner and outer sides of the chamber, the inner tooth is slightly larger.

Length of holotype.—0.80 mm.; width, 0.49 mm.

Holotype from the Moody's Branch Marl on Town Creek, Jackson, Mississippi, where it is crossed by the Great Northern Railroad Bridge. Louisiana State University Museum Collection No. 771.

Distribution.—Common at the type locality; fairly common at the exposure of Moody's Branch Marl on Garland Creek. Clark County, Mississippi, N. W. Corner of sect. 28, 1 N., 16 E.; 2-10 of a mile east of the bridge over Garland Creek.

---

[1] Howe, H. V., 1934; Jour. Pal., vol. 8, no. 4; p. 420, pl. 51, figs. 7 a, b.

Spiroloculina bidentata differs from *Massilina occlusa*[2] (a common species in the Byram Marl) in being more broadly elliptical in side view and by having the distal end of the final chamber less elongate; in the Byram Marl species, the contact between adjacent chambers is much smoother.

Genus BAGGINA Cushman, 1926

Baggina xenoula Hadley, n. sp. Plate 1, figs. 5 a-c

Cancris sp., Howe; Guide book to Eleventh Annual Field trip of the Shreveport Geological Society, Oct. 1934; correlation chart opposite page 26.

Test trochoid, subglobular, dorsal side somewhat evolute, ventral side involute, with an open and depressed umbilicus, periphery broadly rounded; chambers few, usually five in the last whorl, final chamber considerably larger than any of the others; sutures narrow, slightly depressed, almost straight on both sides; wall thin, clacareous, coarsely perforate except around the central region of the ventral side, which is smooth and clear; aperture a moderately high arch, located at the base of the last formed chamber and on the ventral side, extending from the umbilicus to near the periphery.

Greatest diameter of holotype.—0.34 mm.

Holotype from the west bank of Bucatunna Creek, NW¼ sect. 17, T. 8., R 5 W., Wayne County, Mississippi. Louisiana State University Museum Collection No. 773.

Distribution.—Fairly common at the following localities: Blue Marl below the Chione Limestone, Wayne County, Miss., on east side of concrete highway bridge on highway No. 45, approx. 1½ miles N. of Waynesboro, Miss.; approximately .15 mi. due west of the corner of section 10, 8 N., 7 W, Wayne Co., Miss., on the west bank of the Chickasawhay River. This locality contains the above species in the Lower and Upper members of the Chickasawhay there exposed; NESW, approx. 1-10 mi. SW. of center of section 10, 8 N., 7 W, Wayne Co., Miss., in the Oyster Bed, west bank of the Chickasawhay River; the Blue Marl below the Chione Limestone, Wayne Co., Miss., E. side of concrete highway bridge on highway No. 45, approx. 1½ mi. N. of Waynesboro, Miss.; NW. corner of SWNE of section 24, 9 N., 7 W., 4-10 mi. SE of road intersection with highway No. 45; SE. corner of SW. quarter of sect. 10, 8 N., 7 W., Wayne Co. Miss., on E.

---

[2] Cushman, 1922; U. S. G. S. Prof. Paper No. 129; p. 104, pl. 28, fig. 2.

bank of Chickasawhay River; about 2 miles due south of Waynesboro, Miss., on S. bank of Chickasawhay River 2-10 mi. W. of S. end of highway bridge.

The specimens of this species were obtained from material in the collection of Dr. Howe.

The above species differs from *Baggina californica*[3] by being more evolute and by having the chambers more rounded on the dorsal side.

Genus PULVINULINELLA Cushman, 1926

Pulvinulinella harrisi Hadley, n. sp. Plate 1, figs. 6a-c

Test large, trochoid, biconvex; with a low, rounded, transparent keel; dorsal side only slightly convex, evolute; ventral side conical, strongly convex, involute; dorsal chambers angular in outline, slightly wider than high, seven making up the last coil in a normal adult; earlier chambers not well defined, the central area being covered by a low, wide boss of clear shell material through which pore canals are visible in some specimens; ventral chambers triangular in outline, wider than high, only the last whorl visible; umbilical area occupied by a small, high, clear boss; sutures on both sides only slightly curved, limbate and practically flush with the chambers, those on the dorsal side are oblique, ventral ones radial; wall calcareous and heavy, thickly covered with moderately coarse perforations; aperture an elongate slit on the face of the last chamber and lying in the plane of coiling, on the ventral side just below the periphery.

Greatest diameter of holotype.—0.80 mm.; thickness—0.42 mm.

Holotype from the Moody's Branch Marl on Town Creek, Jackson, Mississippi, where it is crossed by the Great Northern Railroad Bridge. Louisiana State University Museum Collection No. 774.

To date I have found this species at the above locality only. Named in honor of Professor G. D. Harris.

P. harrisi is of fairly rare occurence. It might be confused with *Eponides jacksonensis* upon hasty examination, but if the aperture is noted, there can be no mistake as to its identity.

---

[3] Cushman, J. A., 1926; Contribs. Cushman Lab. Foram. Res., vol. 2, pt. 3; p. 64, pl. 9, figs. 8a-c.

This species conforms to the original description of the genus *Pulvinulinella*[4]. Dr. Cushman places this genus in the family *Cassidulinidae*. None of the genera assigned to the above family, with the exception of *Pulvinulinella* possess a keel or an umbilical plug. *P. culter*[5] (Parker and Jones) and *P. interrupta*[6] Cushman possess well developed keels. The chambers of *P. harrisi* show no tendency to alternate or overlap, the aperture is a straight slit (not curved), and its punctations are coarser than those observed on any members of the family *Cassidulinidae*. I believe that the true position of *Pulvinulinella harrisi* and all other true specimens of the genus *Pulvinulinella* is in the family *Rotalidae*.

Genus BIFARINA Parker and Jones, 1872

Bifarina tombigbeensis Hadley, n. sp. Plate 1, figs. 7a, b

Elongate, axis of test straight or nearly so; biserial portion making up about one fourth of the entire length, moderately compressed, with a smooth, broadly rounded periphery; uniserial portion broadly elliptical in cross section, composed of seven chambers in the holotype which gradually increase in height toward the distal end; sutures transverse, depressed, not pronounced; periphery slightly lobate in the later portion of the test; wall calcareous, coarsely perforate; aperature slightly eccentric, an elongate slit with a low rounded lip.

Length of holotype.—0.59 mm.

Holotype from Wood's Bluff, Alabama. Louisiana State University Museum Collection No. 775. Common at the above locality. The specimens were obtained from some material in the collections of Dr. Howe at L. S. U.

Bifarina tombigbeensis differs from *B. vicksburgensis* (Cushman)[7] by being less compressed, by having a smaller portion of the test's length occupied by the biserial chambers, and by not having a serrate periphery.

The holotypes of the seven new species described in this paper have been deposited in the collection of the Geology Department at Louisiana State University, Baton Rouge, La. Topotypes have been sent to The Paleontological Research Institution, 126 Kelvin Place, Ithaca, New York and to The Cushman Laboratory of Foraminiferal Research, Sharon, Mass.

---

[4] Cushman, 1926; Contribs. Cushman Lab. Foram. Res. vol. 2, pt. 3; p. 62, pl. 9, figs. 9a-c.

[5] See l.c. vol. 5, pt. 4, pl. 14, figs. 13a-c.

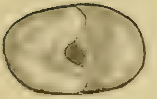
[6] Cushman, 1927; l.c., vol. 3, pt. 2; p. 113, pl. 22, figs. 10a-c.

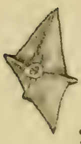
[7] Cushman, 1922; U.S.G.S. Prof. Pap. No. 129; p. 126, pl. 29, fig. 2.

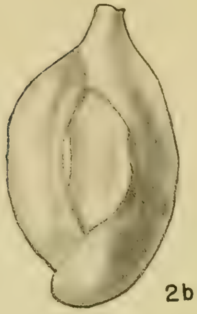
The three new species from the Moody's Branch Marl of the basal Jackson (*Massilina goniopleura, Spiroloculina bidentata*, and *Pulvinulinella harrisi*) are from a paper on the foraminifera of the Jackson which the writer is now preparing.

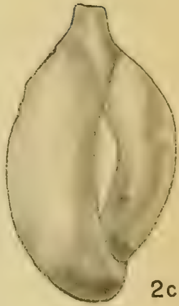
PLATE 1

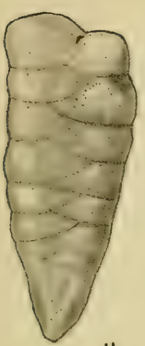
Figure		Page
1.	**Guadryina koimetercola** Hadley; a, end view; b, side view of holotype	3
2.	**Massilina goniopleura** Hadley; a, end view (not of holotype) b and c, side views of holotype	3
3.	**Bitubulogenerina chickasawhayica** Hadley, side view of holotype	4
4.	**Spiroloculina bidentata** Hadley, a, side view; b, end view of holotype	5
5.	**Baggina xenoula** Hadley, a dorsal view; b, ventral view; c, peripheral view, a and c are of holotype	6
6.	**Pulvinulinella harrisi** Hadley, a dorsal view; b, ventral view; c, peripheral view of holotype	7
7.	**Bifarina tombigbeensis** Hadley, a, end view (not of holotype); b, side view of holotype	8

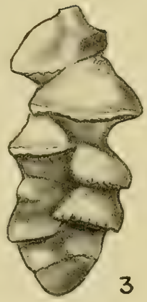

1a

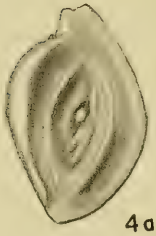

2a

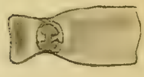

2b

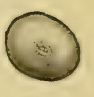

2c

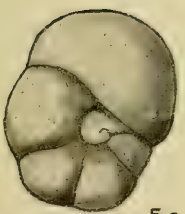

1b

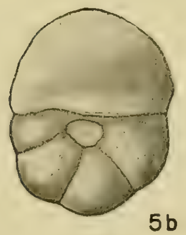

3

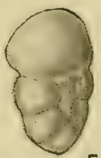

4a

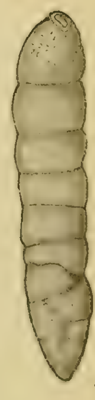

4b

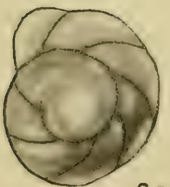

7a

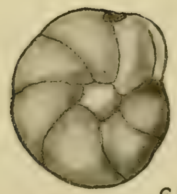

5a

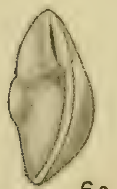

5b


5c


7b


6a


6b


6c

BULLETINS

OF

AMERICAN PALEONTOLOGY

Vol. 22

*

No. 75

The Stratigraphy and Paleontology of Northwestern Pennsylvania
Part II: Paleontology

Section A: The Cephalopod Fauna of the Conewango Series of the Upper Devonian in New York and Pennsylvania

By R. H. Flower and K. E. Caster

August 23, 1935

Ithaca, New York,
U. S. A.

THE STRATIGRAPHY AND PALEONTOLOGY OF NORTHWESTERN PENNSYLVANIA. PART II:

PALEONTOLOGY

Section A: The Cephalopod Fauna of the Conewango Series of the Upper Devonian in New York and Pennsylvania

By Rousseau H. Flower and
Kenneth E. Caster

ACKNOWLEDGMENTS

In a revisionary paleontologic work of the sort which this paper initiates for the Conewango series the student is indebted to so many individuals and institutions for materials and advice that a full acknowledgment with heartfelt gratitude can not be made to all for want of space. To a few of our many silent collaborators we desire especially to convey our appreciation for materials and for generous and patient assistance. Among these should be included Mr. C. M. B. Cadwalader, Managing Director, and Dr. H. A. Pilsbry and the Board of Trustees of the Academy of Natural Sciences of Philadelphia for the loan of a large part of the collection of fossils made in northwestern Pennsylvania by various men connected with the Second Geological Survey of Pennsylvania; Professor Carl O. Dunbar of Yale University for the opportunity to study at Cornell a large suite of fossils collected by the late Professor C. E. Beecher of Yale from the area of Warren, Pennsylvania; to Mrs. Jesse Armstrong and Professor A. C. Swinnerton of Antioch College for the loan of the E. J. Armstrong collection of fossils from the vicinity of Erie, Pennsylvania; Mr. Edward Lindsey, Secretary, and the Warren Academy of Science for the loan of paleontological materials belonging to that body which were collected by the late F. A.

Randall of Warren, Pennsylvania; the Board of Education and the officers of the Warren High School for the loan from the Warren High School of a large part of the Henry Cobham collection of fossils from about Warren; and to Mr. Charles Butts of the United States Geological Survey for the loan of a collection of fossils from the Lewis Run sandstone[1] at Lewis Run, Pennsylvania.

The expense of preparation and photography of the fossil materials of a considerable portion of this paper has been met through a Grant-in-aid by the National Research Council to the associate author for the purpose of completing his stratigraphic and paleontologic studies of the "Pocono problem". With this timely and welcome assistance the much needed study of the marine faunas of western and northwestern Pennsylvania, which are presumably in part at least of "Pocono" age, will be brought to a more rapid completion than would have been otherwise possible.

Our sincerest gratitude goes to Professor G. D. Harris of Cornell University for the use of his photographic and other equipment and for his kind interest in the entire project as well as for the invaluable opportunity of publication. It is also of considerable satisfaction to know that our type material will be securely housed and properly cared for in the fireproof vault of the Paleontological Research Institution which Professor Harris has sponsored, to his everlasting credit. May this institution grow and prosper and ever increase in usefulness to students of paleobiology. May it also quicken interest in and appreciation for paleontologic research in the community in which it was established.

The associate author of this paper wishes to express his appreciation to his many students in geology and paleontology at Cornell University who have enthusiastically collected fossils with him and generously contributed the fruits of their efforts to his cause. The principal author of this paper of cephalopods is such an one whose zeal and enthusiasm have been exceptional and whose sustained interest has been most gratifying.

---

[1] Described below in this report.

In its paleontologic aspects this paper is a joint undertaking but for all stratigraphic details of the paper the associate author must be held entirely accountable.

Kenneth E. Caster

Laboratory of Paleontology
Cornell University
Ithaca, N. Y.
July 15, 1935.

INTRODUCTION

It is hoped that the publication of this paper on the Cephalopoda of the Conewango series of New York and Pennsylvania will be followed soon by others now in progress on additional elements of the highest Devonian and the lowest Mississippian faunas in the area adjacent to the southeastern corner of Lake Erie. This faunal information is necessary for settling the longstanding controversy as to the significance of the Mississippian elements reported from the Conewango series and of Devonian elements purportedly carrying through into the Oil Lake series of the Mississippian. From a stratigraphic point of view this initial paper will not prove too helpful, for of all the major elements of the Conewango series, the Cephalopoda have proven least satisfying due to the very limited information at present available concerning the nature and range of the Mississippian and Chautauquan (Devonian) cephalopod faunas of eastern North America. The brachiopod and pelecypod studies are well under way, and a rich echinoderm fauna is being prepared for investigation. These papers, when they appear, it is believed, will be of greater stratigraphic value. All of these paleontologic papers, it is projected, will appear as companion studies to the stratigraphic discussion of the area which is already published[2].

---

[2] Caster, K. E. The stratigraphy and paleontology of northwestern Pennsylvania. Part I: Stratigraphy. Bull. Amer. Paleontology, vol. 21, No. 71, p. 1-185. 1934.

This paper on the Conewango cephalopods of Pennsylvania and New York will at best give only a faint picture of the complete cephalopod fauna which it is believed is still buried in these rocks. No cyrtoceracones, gyroceracones or tarphyceracones are yet known from the Conewango, while the nautilicones and the ammonoids are each represented by a single species. Further collecting will doubtless yield more representatives of the tarphyceracones, nautilicones and ammonoids. The wealth of fragmental material of orthoceraconic species in unsatisfactory preservation is very great and lends excellent reason to assume that many orthoceraconic genera and species will yet be added to the Conewango fauna. Particularly are the Warren and Tidioute areas rich in such material.

STRATIGRAPHY

The cephalopod fauna discussed in this paper is found virtually exclusively, so far as is known, in the Conewango series of the Allegany Plateau area. *Bradfordoceras* descends at least to the Chadakoin shales of the upper Conneaut stage. It is surmised that several of the other genera, recognized as new in this paper, will eventually be determined in Chautauquan strata, and *Bradfordoceras* may extend much lower, but the inadequacy of former studies and an insufficiency of materials as yet largely precludes detailed range determination. Likewise it appears from a preliminary study of the Mississippian faunas from northwestern Pennsylvania that at least most of the new genera of this paper will extend upward into strata of that age. It now seems doubtful whether this is true for any of the species.

Lewis Run Sandstone member.—The stratigraphy of the highest Devonian and lowest Mississippian strata in the area adjacent to the southeastern corner of Lake Erie has been previously summarized[2] by the associate author. When begun, this paper was intended to be descriptive of an unusual assemblage of cephalopod and other fossil remains which occur in a locally massive sandstone in the lower part of the Amity shale of the Venango stage of the Upper Devonian which is well developed in the ceramic quarries at Lewis Run, McKean County, Pennsylvania. However it has been found feasible to incorporate in this paper the whole Conewango, thus making it first of a contemplated series of more inclusive papers on the highest Devonian fauna in the Allegany Plateau province. The local massive sandstone alluded to above occurs in the red or Cattaraugus parvafacies of the Smethport magnafacies[1]. The marine fauna of this member, for which the name *Lewis Run sandstone* is hereby proposed, while unusually abundant in species and in individuals as has been previously briefly pointed out[3], is only in degree different from a seaward subfacies[4] of the Smethport magnafacies throughout the Upper Devonian of the Penn-York embayment[5]. A more detailed paleontological study of this Upper Devonian red subfacies will be outlined at another place. The Lewis Run sandstone is typically a deep reddish purple, coarse, quartz-grained sandstone which occasionally carries a scattering of flat pebbles of vein quartz and rarely of jasper. The matrix material is vividly reddish purple in color. Except for the red color at the type occurrence, the member is very similar to the other conglomerate lenses which occur in the Venango stage. The horizon of the sandstone has been determined on the basis of surface measurements as being presumably 30 feet below the Salamanca conglomerate horizon and at some distance above the Wolf Creek conglomerate horizon which is apparently beneath the surface at Lewis Run. The Lewis Run sandstone may quite possibly occupy a stratigraphic position essentially equivalent to the Dutchmans conglomerate[2] of the Warren area. If such is the case, they are presumably non-continuous. Faunally they are not strikingly similar.

Beneath the Lewis Run sandstone there is a red shale member or zone, presumably of Amity age, which is utterly barren of fossils. Likewise olivaceous to green, silty and sandy, micaceous beds which immediately overlie the sandstone are essentially barren. Fossil plants are occasionally present in the latter, however, and may characterize the Salamanca equivalents at Lewis Run. Still higher in the section typical Cattaraugus red shales and sandstones occur above the horizon of the Salamanca conglomerate.

---

[3] Caster, K. E. Upper Devonian marine fauna in the seaward phase of the Catskill magnafacies, (abstract). Preliminary list of titles and abstracts of papers to be offered at the forty-seventh annual meeting of the Geological Society of America, p. 73, 1934. (To be published in the Bull., Geol. Soc. America, vol. 46, 1935.)

[4] *Idem.*

[5] *Idem.*

PRESERVATION

Most of the cephalopod material from the Conewango series, which is sufficiently well preserved for satisfactory study, occurs in sandstone and conglomerate lenses and in local bioherms or coquinites. The Salamanca, Wolf Creek, Panama and Dutchmans conglomerates, the Lewis Run sandstone and the coquinites of Panama age and slightly younger, in the Amity shale member, are the chief cephalopod horizons.

The Lewis Run sandstone, despite the abundance of the remains, is not a favorable medium for the preservation of cephalopods, because the coarse sand grains obscure the fine markings of the exterior and the delicate internal parts. Longitudinal sections of specimens filled with the sandstone show a slight difference in texture between the filling of the siphuncle and the contents of the camerae, but the connecting rings, septal necks, siphuncular deposits, circumferential deposits and sometimes even the septa are dissolved away and cannot be readily ascertained. Fortunately a few specimens were found the camerae of which were replaced with calcite. In such specimens the structure of the septal necks, connecting rings, internal siphuncular deposits and the circumferential deposits of the camerae were beautifully preserved, though weathering had attacked these forms so that the circumferential deposits and the peripheral portion of the septa and likewise the wall of the conch were represented only by limonitic bands. Centrally the structure was better preserved, for the lamellose character of the internal deposits of the siphuncle was frequently readily ascertained, and sometimes the connecting rings and the septal necks were calcareous and had remained largely intact.

The internal molds were often greatly distorted in the Lewis Run sandstone, Salamanca conglomerates and elsewhere in the Conewango. Some specimens definitely show places where the shell was broken, as on pl. 8, fig. 3-4, while others which are definitely distorted present a smooth and unbroken surface, not only on the wall of the conch, but frequently in the septa. The description of such species presents a definite problem, for compressed and depressed representatives of the same species frequently present very different aspects.

Experiments in which plasticine models were subjected to pressure served partially to eliminate this difficulty. The models were based upon some undistorted calcite-filled specimens of *Bradfordoceras transversum,* which has oblique but not sinuous sutures, and a siphuncle located twice as far from the dorsum as from the venter. When the model was depressed, the formation of ventral lobes between ventro-lateral saddles on one side, and the increase in the curvature of the dorsal saddles on the other resulted. On the other hand, compression resulted in asymmetrical sinuous or undulate suture patterns, almost identical with those shown on pl. 8, fig. 3-4. Sutures which were originally oblique and faintly sinuous, and in which the sinuosity was confined to the zones of greatest obliquity on the lateral portions of the sutures so that the greater extent of the dorsal and ventral regions was transverse, when subjected to compression developed a definite pattern of lobes and saddles. These lobations were asymmetrical, however, for the sutures ascended adaperturally more on the dorsum than on the venter.

As might be anticipated, it was commonly found that compression or depression was more or less oblique, and even frequently longitudinally oblique. The holotype of *Anglicornus anneliesae* has suffered from such longitudinally oblique pressure. The pressure was directed along a line entering the specimen near the right side of the aperture and passing through the left side of the phragmacone. This resulted in the formation of a lateral sinus in the aperture of the specimen which the organism never possessed in life, and also resulted in the formation of oblique sutures.

Compression or depression alike tended to move the siphuncle nearer the margin, and often resulted in an increased convexity of the septa.

It is of utmost importance to distinguish between compressed and depressed specimens. Where the direction of the force in relation to the specimen is uncertain, the term distortion is used. In referring to oblique compression or depression it is sometimes necessary to give the angle which the line of force makes with either the transverse or original dorso-ventral diameter of the conch.

Preservation in a coquinite of Panama age yielded our most perfectly preserved specimens. Here there was apparently no distortion, and the surface of the shell and the internal parts were beautifully preserved.

Preservation of the interior was likewise favorable in the specimens from the Pope Hollow conglomerate member of the Salamanca. Specimens from this horizon show good siphuncles when sectioned, but the internal deposits could not be made out. This horizon contained considerable pyrite, and a few of the conchs were entirely replaced by it. Sections of some of these were made, but none were as satisfactory as those from the finer grained portion of the sandy material. A number of excellent natural siphuncles of a form of *Bradfordoceras,* presumably belonging to one of the variants of *B. hector,* were obtained from this formation. One of these is shown on pl. 3, fig. 6.

ECOLOGICAL NOTE

The cephalopods furnish the element in the Lewis Run sandstone fauna which is most likely to be foreign. The light and presumably air-filled conchs might easily have been transported to the faunule. It would seem, however, from the evidence of the shells themselves that this was probably not the case. Though many of the conchs are fragmentary, good sized pieces occur, and they are not more broken up than are other cephalopods which are found in normal marine strata. An additional argument may be found in the gigantism of *Neocycloceras obliquum,* which is much larger than *N. harrisi* or *N. lilianae* of the typical marine non-red Salamanca conglomerate. *N. cadwalderi* is intermediate in size, but is probably not as closely related to any of these three species as they are to each other.

Bradfordoceras transversum, the largest species of the Conewango, is exceedingly abundant in the Lewis Run sandstone but is not confined to it. A few fragments are known from the Salamanca from near Warren, Pa. This is a slightly later stratum, and the occurrence of these fragments might be accounted for in either of two ways. It might be assumed that this species originated in the Lewis Run and lived on to the Salamanca, retaining its characters after entering a typical marine environment, or it might be that this species lived in similar and as yet undiscovered marine Cattaraugus facies of Salamanca age. The quantitative evidence alone would indicate that this species was indigenous to the Lewis Run.

Both of the breviconic species are new, but one of them, *Anglicornus anneliesae,* is represented in the Salamanca. In both are to be seen simple generalized apertures which are only slightly constricted. These hearken back to the generalized forms of the Ordovician and are paralleled by some other Devonian types such as *"Poterioceras" tumidum* of the Nunda stage (Ithaca), though they are generically distinct from them. The heyday of the brevicones is in the Silurian, and the species which persisted into the late Devonian and Mississippian were of a simpler, more generalized type, and by all analogy, a type which was as well highly adaptable. These two forms may really have lived in the iron-charged environment of the Lewis Run sandstone.

While other members of the Lewis Run faunule have produced genetic mutants in great variety, the cephalopods fall readily into several clearly delimited species of strikingly constant characters. *Neocycloceras obliquum* variety *geronticum* may possibly represent a genetic mutant. The annulations of the true *N. obliquum* are variable, but scarcely more so than in some species which occur in marine limestones, notably *Dawsonoceras thoas* (Hall)[6].

---

[6] Hall, James. Paleontology of New York, vol. 5, pt. 2, p. 261-3, pl. 41, fig. 1-9; pl. 78 B, fig. 5; pl. 79, fig. 13; pl 80, fig. 7, 10, 11; pl. 112, fig. 7-8. 1879.

Further, in *N. obliquum* the variablility appears to be too gradational to show distinct mutants.

In sharp contrast to the uniformity of the Lewis Run forms is the great variability of the gerontic characters of the cephalopods of the Salamanca suite. The species of *Neocycloceras* show scarcely any variation, but among the species of *Bradfordoceras* the constriction of the camerae and the thickening of the walls of the living chamber occurred at various stages. Such variability among fossil remains is of course difficult to explain. Variability is usually attributed to an attempt on the part of the organism to adapt itself to changing conditions. But here the characters involved are those believed to be concerned with senility and are certainly an indication of a slowing up of the rate of growth. It is possible that apparently original iron pyrite which is abundant in the Salamanca at Tidioute and which is somewhat less abundant but still present at the same horizon in the Warren region might account for this, for water charged with sulfides would furnish an unfavorable environment for organisms which might result in an erratic retardation of growth. The exact taxonomic significance which is to be given to these variations is still unknown. We have described them under the non-committal term of *variant*. It is quite possible that when larger collections are made of material from the Salamanca, that *Orthoceras warrenense* Miller may prove to belong to this series of *Bradfordoceras*.

RELATIONSHIPS

The cephalopods of the Conewango described below fall into seven genera, five of which are new. The one ammonoid present appears to belong to *Paralegoceras,* a genus formerly known to range from the Mississippian through the Permian, and which reaches its heyday in the Pennsylvanian. When subsequent investigation has made known the dorsal sutures of this Devonian species, it may prove to be an as yet undescribed ammonoid genus. At present the stratigraphic significance of this form seemingly of such definite Carbonic stamp in the lower part of the Venango must not be overemphasized. The family Glyphioceratidae to which this genus belongs has been previously known from the Devonian.

One species has been referred to *Pseudorthoceras* Girty, another Pennsylvanian genus, which will probably be recorded from the Mississippian when the cephalopods of that formation have been more thoroughly studied.

Bradfordoceras is prolific in the Conewango, being represented by at least six species, one of which, *B. hector,* is highly variable. Though distinct from the Pennsylvanian genera of the Pseudothoceratidae described by Miller, Dunbar and Condra in their monograph of the Pennsylvanian nautiloids, it belongs in this family, as is explained below. It is not known how far down in the Devonian the Pseudothoceratidae can be traced. As yet, *Bradfordoceras* is known definitely only from the Conewango, with the doubtful addition of some specimens from the Chadakoin. *"Loxoceras" bebryx* of the Ithaca stage and *"Loxoceras" luxum* of the Schoharie grit will probably be found to belong to the Pseudorthoceratidae.

Carlloceras a new genus of nautiliconic species, recalls in so many respects Hyatt's *Domatoceras* that we have ventured to place it in the Koninkioceratidae, which previously contained a number of Carboniferous genera and the genus *Potoceras* which is doubtfully Devonian according to Hyatt[7].

The affinities of the new genus *Neocycloceras* are not clear.

The only annulated Devonian form with transverse markings known outside of these Conewango species, is an as yet imperfectly known undescribed form from the Hamilton stage. The species attributed to *Cycloceras* from the Ordovician and Silurian are almost certainly not congeneric with the true *Cycloceras,* as the genotype is from the Pennsylvanian of Europe, and no congeneric forms are known from the Pennsylvanian strata of America. This matter cannot be cleared up until more is known concerning the structure of the genotype, for in the present state of knowledge the early and late Paleozoic forms attributed to *Cycloceras* cannot be differentiated.

[7] Hyatt, Alpheus. Cephalopoda, Zittel - Eastman Textbook of Paleontology, 1st ed., vol. 1, p. 525. 1900.

The one feature of the Conewango cephalopods which definitely harkens back to the earlier Devonian and older forms is found in the breviconic species. Two species are described below, both from the Lewis Run sandstone. One of these, *Anglicornus anneliesae* is congeneric with *A. nastutum,* which Chadwick[8] lists from the Canadway under the genus *Poterioceras.*

Whereas the nautiloids of the Ordovician and Silurian have received much attention and those of the Pennsylvanian have been recently monographed, the Devonian and Mississippian nautiloids have been so long neglected that a complete reworking of both is necessary before it will be possible to state definitely at what horizon a given genus begins or ends. The principal author of this paper is at present engaged upon a restudy of the Devonian nautiloids of New York.

Order NAUTILOIDEA Zittel

Suborder ORTHOCHOANITES Hyatt

Family ORTHOCERATIDÆ? Hyatt

NEOCYCLOCERAS Flower and Caster, gen. nov.

Genotype: *Neocycloceras obliquum* Flower and Caster, sp. nov.

Slender annulated orthoceracones of circular or very slightly depressed section. The annulations are large, sinuous and slightly oblique. The sutures are more oblique than the annulations, ascending adaperturally on the venter. In the neanic stage the inclination of the sutures is slight and uniform throughout, but in the ephebic stage the inclination is greater and the sutures are sinuous; transverse upon the dorsum, actually forming a very low broad saddle which is flanked by lateral lobes. The venter is occupied by a high conspicuous saddle. The siphuncle is subventral, being located in the ephebic conch half way between the center and the ventral wall. In the neanic stage the siphuncle is slightly more central in position. In section the siphuncle is nummuloidal, the ratio of its diameters at the passage through the

---

[8] Chadwick, G. H. Faunal Differentiation in the Upper Devonian. Geol. Soc. Amer., Bull., vol. 46, p. 324. 1935.

septa and at the point of greatest width within the camerae being as two is to three. The interior is covered with a continuous lamellar deposit which is thickest at the broadest part of the siphuncle and very thin at the septal necks. A similar structure was found in *Pseudorthoceras* Miller, Dunbar and Condra[9]. The septal necks have not been observed. They may prove to be sufficiently recurved to merit the inclusion of this genus in the Cyrtochoanites, but on the other hand they may present a condition analagous to that of *Spyroceras clintoni* (Miller) which possesses moderately expanding siphuncular segments and yet has been retained in the Orthochoanites by Dr. Rudolph Ruedemann[10].

The camerae are oblique and very shallow, scarcely increasing in length throughout the length of the conch; the shallowness and obliquity are such that a plane perpendicular to the axis in the ephebic stage would cut three of them.

The surface and thickness of the test are unknown in the genotype. The internal mold bears transverse or slightly oblique lines of growth. These may represent the surface markings, or they may represent structures of the interior or of an inner layer of the shell. Such markings have been found on the internal molds of *Spyroceras caelamen* (Hall)[11] of the Hamilton. Very definite transverse markings are known on *Neocycloceras harrisi.* The large conspicuous annuli are similar to those of the other annulated genera. The genus is separated from other annulated forms by the oblique sinuous sutures and the eccentric nummuloidal siphuncle. *Brachycycloceras* Miller, Dunbar and Condra[12] possesses sinuous sutures and an eccentric siphuncle, but its siphuncle is tubular and the sutures are not definitely oblique.

Orthoceras bipartitum Hall[13], is not congeneric, for the sutures are transverse and the annulations begin at a relatively later stage than they do in the known species of *Neocycloceras.* Hall's *Orthoceras pertextum*[14], from the Ithaca beds, appears to be a good *Spyroceras.*

---

[9] Miller, A. K., Dunbar, C. O. and Condra, G. E. The Nautiloid Cephalopods of the Pennsylvanian System in the Mid-Continent Region. Nebraska Geol. Surv., Bull. 9, p. 77-81. 1933.

[10] Ruedemann, Rudolph. Cephalopods of the Beekmantown and Chazy formations of the Champlain basin. New York State Museum, Bull. 90, p. 445-449, pl. 14, fig. 4; pl. 16, fig. 5-7; text fig. 18, p. 447. 1906.

[11] Hall, James. Paleontology of New York, vol. 5, pt. 2, p. 261, pl. 41, fig. 1-9; pl. 78B, fig. 13; pl. 80, fig. 7, 10, 11; pl. 112, fig. 7, 8. 1879.

[12] *Loc. cit.*, p. 107-9.

[13] Hall, James. Paleontology of New York, vol. 5, pt. 2, p. 313, pl. 113, fig. 21-22. 1879.

Neocycloceras obliquum Flower and Caster, sp. nov.

Pl. 1, fig. 1-10; Pl. 2, fig. 1

Annulated orthoceracones in which the young portion of the conch is circular in section and in which the mature part is very slightly depressed, the transverse diameter of the ephebic portion being almost invariably 2 mm. greater than the dorso-ventral diameter. Measurements at various points show diameters of 19 and 21 mm., 22 and 24 mm., and 26 and 27.8 mm.

The rate of expansion is slight in an undistorted specimen, being 1 mm. in a length equal to the dorso-ventral diameter of 9 mm., (Paleontological Research Institution specimen no. 5001), and 3 mm. in a length equal to a dorso-ventral diameter of 21 mm. (specimen no. 5007).

The sutures are oblique, sinuous, and slant adaperturally on the ventral side. A broad low dorsal saddle is flanked by lateral lobes which rise steeply to a high ventral saddle. A plane perpendicular to the axis of the conch will cut three of the septa. The camerae are shallow, sometimes rather irregular in depth, several consecutive camerae in one fragment measuring 2 mm., 2 mm., 1 mm., 2 mm., 2 mm., and 1.5 mm., (pl. 1, fig. 9). Most other specimens have shown a rather uniform depth, and the camerae increases only slightly throughout the length of the conch. Where the diameters are 12.5 and 14 mm., the camerae are normally 2 mm. in depth, there being seven in a space equal to the width of the conch. In a large, slightly compressed specimen, where the diameters are 24 and 32 mm., the camerae are 3 mm. in depth, there being ten and one-half in a space equal to the width. From these dimensions it can be estimated that were the specimen uncompressed the diameters would be 27 and 29 mm., and there would be nine and one half camerae in a portion equal to the width of the conch.

Septa slightly oblique. The greatest depth is slightly nearer the dorsal wall than the ventral wall. Where the diameters of the conch are 21 and 23 mm., the highest point is vertically 3 mm. from the dorsal suture and 9 mm. from the ventral suture, being 4 mm. from the mid-lateral portion of the suture.

---

[14] *Idem,* vol. 5, pt. 2, p. 314, pl. 90, fig. 16-17.

The siphuncle is located half way between the center of the conch and the ventral wall, but is slightly less eccentric in the younger stages. In a young portion, the siphuncle is 1.5 mm. in diameter at its passage through the septa, and is 2 mm. from the venter and 5 mm. from the dorsum. In a more mature stage, where the siphuncle is 2.5 mm. in diameter, it is situated 6 mm. from the ventral wall and 16 mm. from the dorsal wall.

Where the passage through the septa is 1.3 mm., the siphuncle expands at the middle to 2.0 mm. where the depth of the camera is 2.4 mm. In one specimen in which the camerae were filled with calcite, an internal lamellar secretion can be seen on the interior of the siphuncle. This is thickest at the most convex portion, and thins greatly toward the septal necks. The septal necks have not been seen in any of the specimens sectioned. They may prove to be slightly recurved.

Composition and thickness of test unknown. Unless the sinuous lines of growth represent surface markings impressed upon the internal mold, no surface markings are known. The annulations are high, conspicuous and distant. Their sinuosity and irregularity are conspicuous features of the conch. The slant is usually slight, directed adaperturally on the venter.

The annuli appear as sharp, well-raised ridges with the interspaces slightly concave in the mature portion. The diameter in the ephebic stage is one-fifth greater across the annuli than across the middle of the adjacent adapical interspaces. The frequency of the annuli is highly variable. In a typical form there may be two or three annuli in a space equal to the diameter of the conch. The distance between annuli usually varies greatly and does so in an irregular manner.

A fragment of a young portion, (pl. 1, fig. 6), which has dorsoventral diameters at the ends of 9 and 10 mm., is 13 mm. in length. The annuli occur at a rate of 3 in a length equal to the adapertural diameter, but differ from the ephebic annuli in being very low and inconspicuous with flat interspaces. In this specimen the diameter across one of the annuli is 11 mm. The adjacent interspace shows a diameter of 9.5 mm.

The living chamber is about twice the diameter at the last septum in length. In *Neocycloceras obliquum s.s.* there is no evidence of any gerontic variation in ornamentation and specimens with a diameter up to 30 mm. are known, (pl. 1, fig. 4). The aperture follows the slightly obliques, sinuous path of the annuli and lines of growth. There is no trace of a hyponomic sinus.

Types.—Holotype,—Pal. Res. Inst., Cat. No. 5000.
Paratypes.—Pal. Res. Inst., Cat. Nos. 5001-5012.

Occurrence.—The red Lewis Run sandstone member of the Venango stage of the Upper Devonian, Lewis Run brick quarry, Lewis Run, Pennsylvania.

Neocyloceras obliquum var. **geronticum** Flower and Caster, var. nov.
Pl. 2, fig. 2

This variety is described from one somewhat compressed fragment, consisting of a mature living chamber and six camerae. Section probably circular or subcircular, orthoconic; rate of expansion gradual as in the preceding. Position and elements of siphuncle unknown. The sutures are oblique, with lateral lobes and dorsal and ventral saddles, the dorsal one broad and low, the ventral one narrower and high. Camerae 2-3 mm. in depth as in the typical *N. obliquum.* Condition of normal septa unknown.

The aperture was probably 22 mm. in diameter. In the holotype the diameters at the aperture are 19 and 25 mm. The aperture descends adapically on the ventral side forming a shallow hyponomic sinus. The living chamber is 36 mm. in length.

The ornamentation consists of prominent annuli and lines of growth, as in the preceding. The thickness and exterior of the test are unknown. The first interval between the middle of the crests of the annuli is 6 mm., the second is 7 mm. Part of the third annulation invades the base of the living chamber. The third interval is 9 mm. in length, and the next is 17 mm. The aperture is 9 mm. beyond this, and flares as though about to form another annulation.

Discussion.—This differs from the preceding only in having the gerontic characters appearing at a relatively younger stage. The ventral saddle appears to be somewhat narrower, but this may be attributed to compression. The annulations slope definiteby adaperturally on the dorsum instead of on the venter in the holotype, but this may be the result of distortion.

Types.—Holotype,—Pal. Res. Inst., Cat. No. 5013.

Occurrence.—From the Lewis Run sandstone member of the Venango stage of the Upper Devonian, Lewis Run brick quarry, Lewis Run, Pennsylvania.

Neocycloceras harrisi Flower and Caster, sp. nov. Pl. 2, fig. 4, 5, 7-9

This is a small annulated orthoceracone, the early stages of which are smooth. The annuli appear gradually as was shown by Hall for *Spyroceras crotalum*[15], and not suddenly as in *Spyroceras bipartitum* (Hall)[13]. The section is probably circular; all specimens examined had one diameter slightly greater than the other, but the position of the siphuncle showed that these specimens were as often compressed as depressed. The holotype is compressed, having diameters of 8 and 10 mm. at the apical end of the specimen, which increase to 10 and 12 mm. in a length of 15 mm.

All specimens agree in showing a siphuncle which is twice as far from the dorsum as from the venter. In the holotype the siphuncle is 3 mm. from the venter and 6 mm. from the dorsum, and is nearly 1 mm. in diameter. In a slightly smaller specimen in which the diameters were 6.5 and 8 mm. the section being compressed, the siphuncle was 2 mm. from the venter and 4 mm. from the dorsum. This relation remains constant to the earliest stage.

The siphuncle in section appears to be tubular. Ground specimens failed to show any trace of the siphuncle at all, and only one natural section was available for study.

The septa are shallow. Where the diameter is 4 mm. the depth of the septum is 1 mm. and the sutures are apparently straight and transverse. Where the greater diameter is 9 mm. the depth is 2 mm. from the mid-lateral suture, increasing ventrally to 3.5 mm. and decreasing dorsally to 1 mm.

---

[15] *Loc. cit.*, pl. 82, fig. 3-6.

The ornamentation consists of well raised, rounded annuli separated by uniformly concave interspaces in the adult, though in the early stage where the annuli are faint the interspaces are flat. It is impossible to state definitely at what stage the annuli appear. They are absent where the greater diameter is 5 mm., and are well developed where the diameter is 8.5 mm. Where the diameter in an interspace is 9.5 mm., the adapical annulation increases the diameter to 10.5 mm., and the adapertural one to 10.75 mm. The annuli will probably vary slightly, but appear to be 3 in a length equal to the adapertural diameter of 9 mm. The annuli are transverse over the dorsum and the sides, but slope adapically on the venter forming at the aperture a shallow hyponomic sinus. The lines of growth follow the same pattern. These consist of rounded transverse lirae separated by striae of the same width. There are 4 of these lirae in the space of 1 mm. in the mature part of the conch. The surface markings of the early smooth portion are unknown. There are about 10 lirae between the crests of two annuli.

The camerae are fairly regular, there being 4 in a length equal to the adapertural diameter of 7 mm. The living chamber is 21 mm. in length where the diameters at the base are 8 and 10 mm

Discussion.—This species occurs in association with a closely allied one described below. The two are separated upon the basis of the annuli and surface markings. The early stages, shown on pl. 2, fig. 8-9, are devoid of surface markings and are tentatively referred to this species. It is probable, however, that in the material studied the early stages of both species were present, but without the surface markings preserved no way is known to separate the young of the two species. The mature parts of the conchs can be readily specifically identified. They divide about equally, thus seemingly showing that the two species were about equally abundant.

Types.—Holotype,—Pal. Res. Inst., No. 5030.
Paratype,—Pal. Res. Inst., Nos. 5034, 5036, 5037.

Occurrence.—From the Pope Hollow conglomerate member of the Salamanca suite along highway at east end of Tidioute bridge across the Allegany River, Warren County, Pennsylvania.

Neocycloceras lilianae Flower and Caster, sp. nov. Pl. 2, fig. 6, 10.

These are small straight annulated orthoceracones in which the early stage is without annuli, closely remembling the preceding. The section is presumably circular, specimens being as often compressed as depressed. The holotype is slightly depressed, the diameters being 8 and 10 mm. The rate of expansion is gradual, the diameters increasing from 8 and 10 mm. to 10.3 and 11.5 mm. in a length of 15 mm.

The siphuncle is eccentric, being placed twice as far from the dorsum as from the venter. In the holotype the siphuncle is 2.8 mm. from the venter and 4.5 mm. from the dorsum, and is about 1 mm. in diameter.

The elements of the siphuncle are unknown, but are presumably tubular.

The sutures are straight and slightly oblique, as in *N. harrisi.* The septum is shallow, descending 2 mm. from the venter, and 1 mm. from the dorsum where the diameters in a depressed specimen are 8 and 10 mm. At this point the camerae are 2.2 mm. in depth.

The annuli are slightly closer together in this species than in the preceding. In a length equal to an adapertural diameter of 11 mm., this being the greater diameter in a slightly depressed specimen, there are 3.5 annuli. The adapertural extent of this measurement is in an interspace, and the adapical extremity is on the crest of one annulation. The annuli appear to be lower than in *N. harrisi.* Where the diameter in an interspace is 11 mm. the adapical annulus measures 12 mm. and the adapertural one 12.5 mm. These measurements show no outstanding difference between *N. lilianae* and *N. harrisi,* but the breadth of the annuli gives *N. lilianae* the appearance of having shallower interspaces. The interspaces are concave in the adult.

The surface is marked by numerous fine transverse lirae alternating with striae. These are much finer than in *N. harrisi* and are closer together. There are between 16 and 20 in the space between two consecutive crests, and there are 6 to 9 in the space of 1 mm.

The living chamber in a specimen in which the diameters at the last septum are 8 and 10 mm. is 23 mm. in length. The aperture is without any variation in ornamentation. A shallow hyponomic sinus is present, which is reflected throughout the conch in shallow lobes or sinuses in the annuli and surface markings.

Discussion.—The non-annulated early stages described under *N. harrisi* probably apply to this species also. The absence of any trace of transverse surface markings on such early fragments has made it impossible to separate them between these two species, and the depth of the camerae appears to be the same, as is the position of the siphuncle and the form of the septum.

The adults can be distinguished by the difference in the annulations and the surface markings, there being 3 annuli in *N. harrisi* where there are 3.5 in *N. lilianae,* and by the much finer surface markings in *N. lilianae.* Like *N. harrisi* this is a small species, no fragments being known with a diameter greater than 12 mm.

Types.—Holotype, Pal. Res. Inst., No. 5031.
Paratypes, Pal. Res. Inst., Nos. 5032, 5033, 5035.

Occurrence.—In the Pope Hollow conglomerate member of the Salamanca suite, along the highway at the east end of the Tidioute bridge across the Allegany River, Warren County, Pennsylvania.

Neocycloceras? cadwaladeri Flower and Caster, sp. nov. Pl. 2, fig. 3.

The holotype, the only known example of this species, is considerably distorted, and is a fragment consisting of 8 camerae and the base of the living chamber.

The section was probably originally circular or perhaps slightly depressed. The holotype is badly compressed. The rate of expansion of a normal specimen is unknown, but it must be slight, for in the greater diameter of the holotype in a length of 11 mm., there is only an increase in diameter from 11 mm. to 12 mm. At the adapertural end, the diameters are 8 and 13 mm. Assuming a circular section, the diameter here would be 10.5 mm. were the section normal.

There are 9 camerae in a length equal to the actual diameter of 12 mm. at the last suture. The camerae appear to be slightly irregular in depth, although this may be due to the distortion of the specimen. The sutures are very slightly oblique but not sinuous, slanting adaperturally on the left side of the specimen as it is oriented in pl. 2, fig. 3. The adapical camerae do not show this clearly, but compression is greatest at that end. There are 7 annulations in a length equal to the adapertural diameter of 13 mm. The fine surface markings are not preserved.

The condition of the septa, the position of the siphuncle and its internal structure are unknown.

Assuming the section to be circular, the diameters given in the above measurements would be considerably lessened. The diameter at the last septum would be decreased to about 10 mm. There would be 7 camerae in that length. The diameter of 13 mm. would be decreased to 10 mm., a length which would contain not quite 6 annulations.

A portion of the living chamber is 14 mm. in length. There is no sign of the aperture.

The annuli are low, narrowly rounded, and with rather wide interspaces so that the interspaces are nearly flat. In all other species described here the interspaces are concave throughout. The annuli are sufficiently low that the diameter is very slightly increased by them. Where an interspace has a diameter of 11.2 mm., the adapertural annulation has a diameter across its crest of 12 mm.

Discussion.—In spite of the poor state of preservation of the holotype, the only representative of this species known, there can be no doubt that it is distinct from the other Conewango species. The low, frequent annulations with the wide, nearly flat interspaces will distinguish this from all other known species. The annuli of both *N. harrisi* and *N. lilianae* are more pronounced, more evenly rounded, and the interspaces are narrower in proportion and concave throughout. In the corresponding stage of

N. obliquum, both the sutures and the annuli are much more distant.

Types.—Holotype,- Academy of Natural Sciences of Philadelphia, Second Pa. Geol. Surv. Coll., No. 9425.

Occurrence.—The precise horizon of this specimen is unknown, but on the basis of lithology and association it appears probably to be Conewango in age, and probably not lower than the Salamanca suite. F. A. Randall[16] states that the specimen came from the "Sub-Olean" conglomerate, three miles northwest of Warren, Pennsylvania. The species may prove on further collecting to be exclusively of the Tidioute, Knapp (Sub-Olean *ss.*) or Corry formations and therefore wholly Mississippian in range, as Randall's note would intimate. Because of the uncertainty it seems wise to record it among the Conewango forms for the time being, for lithologically the matrix of the specimen is very similar to sandstones of the upper Venango stage.

Family KONINCKIOCERATIDAE Hyatt

CARLLOCERAS Flower and Caster, gen. nov.

Genotype.—*Carlloceras garlandensis* Flower and Caster, sp. nov.

Moderately involute nautilicones in which the whorl is trapezoidal in section, the diameter across the abdominal angles being about half that across the umbilical angles, and with the heighth of the lateral faces about one and one-half times the greatest transverse diameter. The ventral and lateral faces are nearly flat, very slightly convex, but the dorsal face bears an impressed zone about equal to one-fourth the dorso-ventral diameter of the whorl in the most mature stage known, and less in the younger stages. The youngest portion of the conch is unknown, but is presumably gyroconic or possibly tarphyceraconic.

The sutures are sinuous. The dorsal condition is unknown, but appears to have a median lobe which presents the appearance of a dorsal siphuncle. The lateral faces are occupied by lobes which rise dorsally to moderate umbilical saddles, and which rise ventrally to a high ventral saddle which is continued evenly over the ventral face.

---

[16] Cat. Geol. Museum., Second Pennsylvanian Geol. Surv., vol. O, Part III, Warren County Collection, F. A. Randall, p. 26, 1889.

The siphuncle is poorly preserved, but appears to be represented by a small roughened area on the septum near the ventral wall, but slightly removed from it.

The thickness and surface markings of the conch are unknown. The internal mold is smooth.

The general shape of the whorl recalls *Centroceras* Hyatt, but that genus possesses a ventral lobe and is tarphyceraconic. *Domatoceras* Hyatt, which was recently redefined by Miller, Dunbar and Condra,[16] differs from *Carlloceras* mainly in the presence of a ventral saddle, though this too is a little less involute. It would appear that *Carlloceras* presents a condition similar to that of the immature of *Domatoceras* in the form of the sutures, and similar to the adult of that genus in the section of the whorl. Because of this similarity we have placed *Carlloceras* in the Koninckioceratidae.

The genus is named in honor of the late J. F. Carll who was for years the Nestor of geology in the Pennsylvania Oil Region.

The genus is at present known from a single specimen of the genotype, from a sandstone presumably of Salamanca age at Garland, Pennsylvania. It is probable that the genus ranges throughout the Venango stage at least.

Carlloceras garlandensis Flower and Caster, sp. nov. Pl. 2, fig. 12-14.

This species is known only from a fragment which describes a revolution of about 120° and which represents ten camerae and the base of the living chamber. The form is nautiliconic, involute, and a part of the inner whorl can be seen.

The whorl is trapezoidal in section, strongly compressed, the larger base being dorsal. The ventral and lateral faces are very slightly convex, and the abdominal and umbilical angles are slightly rounded. The dorsal face is excavated to receive a portion of the previous whorl.

Where the diameter of the whorl across the abdominal angles is 6 mm., the diameter across the umbilical angles is 10 mm., and the heighth of the lateral face is 15 mm. The greatest transverse diameter at this point is 11.5 mm. This occurs about 2 mm. from the most dorsal extension of the lateral faces.

---

[16] *Loc. cit.*, p. 215-218.

The dorsal part of the suture is unknown. It may be straight as in the majority of nautiloids, or it may posses a median lobe. Such a structure would account for the cicatrice on the mid-dorsal margin shown in pl. 2, fig. 14, a structure which superficially resembles a siphuncle. The lateral faces are occupied by lobes which lie between a low umbilical saddle and a high ventral saddle which continues evenly over the ventral face. Where the heighth of the lateral face is 14 mm., th heighth of the lateral lobe, measuring from a straight line drawn between the most orad extension of the suture at the umbilical and abdominal angles, is 3.5 mm., which is equal to the depth of two camerae.

The septa are very slightly convex, rising not more than 1 mm. from the lateral sutures.

The siphuncle is very small, and is located near the ventral wall but definitely removed from it. It is 3 mm. from the venter, less than .5 mm. in diameter, and 10 mm. from the dorsum, measuring to the middle of the impressed zone. The impressed zone is about 3 mm. deep at this point.

The thickness of the shell and the surface markings are unknown. The internal mold is smooth, showing no evidence of ornamentation.

The form is nautiliconic; the umbilicus is open, but narrowly so.

Discussion.—The small size of the specimen indicates that this may not be a mature form, but whether mature or not, it is certainly a new one. As was pointed out in the discussion of the genus, this appears to belong to a Pennsylvanian group of nautiloids rather than a Devonian one. The shape of the whorl recalls the higher Pennsylvanian groups, but the simplicity of the ventral portion of the suture shows that this form is much more primitive.

Type.—Holotype,- Academy of Natural Sciences of Philadelphia, Second Penna. Geol. Surv., Cat. No. 9632.

Occurrence.—Garland, Pennsylvania. From the strata which F. A. Randall[17] correlated with the Tanner's Hill quarry rock. This quarry is in the Salamanca suite. At this horizon occurs a yellow sandstone (the Millers) on the river cliff at Garland. This formation is not, however, the correlate of the Venango First Oil Sand as Randall supposed[17a].

Suborder CYRTOCHOANITES Hyatt

Superfamily ANNULOSIPHONATA Hyatt

Hyatt[18] divided the Annulosiphonata into three families: the Loxoceratidae, Uranoceratidae and Actinoceratidae. Due to the confusion which exists in regard to the structure of the genotype of *Loxoceras* McCoy, Troedsson[19] later proposed the family name Sactoceratidae to replace the name Loxoceratidae. Unfortunately he published no definition of the group.

Foerste and Teichert[20], in their paper on the Actinoceroids of East-Central North America discussed the families Actinoceratidae, Armenoceratidae, Huroniidae, Gonioceratidae and Sactoceratidae. They define the Sactoceratidae as follows:

> ''In the Sactoceratidae the septal necks have a structure somewhat similar to that of the Actinoceratidae, but on a smaller scale. The siphuncles are usually smaller, compared with the diameter of the conch, and the lateral diameter of their segments usually does not exceed their length, so that the form of these segments usually is approximately globular, though moderately elongated in a vertical direction in some species of *Deiroceras*. Usually the calcareous deposits in the siphuncle are moderate in quantity, and in some specimens may even be absent. Rarely they extend sufficiently into the interior of the siphuncle to constrict the latter into a narrow tube or endosiphuncle.''

In the same paper the following genera were placed in the Sactoceratidae:

---

[17] Cat. Geol. Museum., Second Pennsylvania Geol. Survey, vol. O, pt. III, Warren County Collection, F. A. Randall, p. 31, 1889.

[17a] *Idem.*

[18] Hyatt, Alpheus, Cephalopoda, in Zittel-Eastman Texbtook of Paleontology, 1st ed., vol. 1, p. 527-8. 1900.

[19] Troedsson, Gustaf. On the Middle and Upper Ordovician faunas of northern Greenland, pt. 1, Cephalopods. Jubilaeumsekspedition Nord om Gronland, 1920-23; no. 1, pp. 43, 50, 60, 79, 106. 1926.

[20] Foerste, A. F. and Teichert, Curt. The American Actinoceroids of East-Central North America. Denison University Bulletin, Journal of the Scientific Laboratories, Vol. 25, art. 6, p. 209-210. 1930.

Sactoceras Hyatt
Eskimoceras Foerste
Troedssonoceras Foerste
Ormoceras Stokes
Deiroceras Hyatt

All of these possess annulosiphonate structure to a greater or less degree. These genera are entirely Ordovician and Silurian in age.

Miller, Dunbar and Condra[21] in 1933 placed the genera *Pseudorthoceras, Mooreoceras, Dolorthoceras* and *Euloxoceras* in the Sactoceratidae. None of these possess annulosiphonate structure, and they are either without any deposit within the siphuncle, or with a continuous lamellar deposit on the interior. These, together with the genus *Bradfordoceras* described in this paper, seem to constitute a natural group which has the essential characteristics of the old Loxoceratidae. Indeed, the views of Miller, Dunbar and Condra seem to be in line with those of Troedsson who proposed the Sactoceratidae to replace Loxoceratidae.

The Sactoceratidae must stand as described by Foerste and Tiechert inasmuch as *Sactoceras* is included in the group and it was not previously defined.

The late Paleozoic genera assigned to the Sactoceratidae together with the genus *Bradfordoceras* described below, seem to be of sufficient affinity and as a group sufficiently isolated to warrant the erection of a new family for their reception. For this group the name PSEUDORTHOCERATIDAE is proposed, Pseudorthoceras being taken as the type genus partly because its structure has been adequately described by Miller, Dunbar and Condra,[22] and partly because the genotype is sufficiently widespread in the Pennsylvanian that it is fairly accessible for purposes of study.

The Pseudorthoceratidae may be regarded as replacing the Loxoceratidae as defined by Hyatt. It will be convenient to retain the family Loxoceratidae to contain the genus *Loxoceras* McCoy until the problem concerning the structure of the siphuncle of the genolectotype is cleared up. *Orthoceras breynii* has been selected as the genolectotype by Bassler[23]. Nothing is known concerning the siphuncular structure of this species; consequently it will be impossible to refer new forms to the genus until sections can be made of this species. When such studies are made it may develop that the name Pseudorthoceratidae ought to be abandoned in favor of the older term Loxoceratidae if the structure of *Loxoceras* should prove to be of the Pseudorthoceroid type.

---

[21] *Loc. cit.,* p. 77-101.
[22] *Loc. cit.,* p. 77-81.

PSEUDORTHOCERATIDAE Flower and Caster, fam. nov.

Cyrtochoanitic orthoceracones or slightly curved cyrtoceracones in which the septal necks are longer than the brims, and in which the connecting ring does not attain the adoral septum. Deposits within the siphuncle, if present, limited to a continuous lamellose lining, exhibiting neither actinosiphonate nor annulosiphonate structure. The connecting rings may be subcylindrical to supspherical, but are never broader than long.

Discussion.—The phylogenetic relations of the group are not yet clear. This may represent a stock descending from the other Cyrtochoanitic forms, notably the Sactoceratidae, in which the deposits have become simplified. Certainly the absence of any Ordovician or Silurian species which can be referred definitely to this group indicates a late origin. On the other hand, the more nearly cylindrical siphuncle in the apical portion of *Pseudorthoceras knoxense* (McChesney) described by Miller, Dunbar and Condra[24], might be taken as an indication of an independent origin from the Orthochoanites.

The following genera are assigned to the Pseudorthoceratidae:

Pseudorthoceras Girty
Mooreoceras M., D. and C.
Dolorthoceras M., D. and C.
Bradfordoceras Flower and Caster

The characters of the family Pseudorthoceratidae are outlined in the following table:

---

[23] Bassler, Ray S. Bibliographic Index of Ordovician and Silurian Fossils. U. S. National Museum, Bull. 92, vol. 2, p. 767. 1915.

[24] *Loc. cit.*, p. 83-84.

PSEUDORTHOCERATIDAE

	I	II	III	IV	V	VI	VII	VIII
Pseudorthoceras	1	1	1	2	2	2	1	1
Mooreoceras	2	2	2	2	2	1	2	1
Dolorthoceras	2	1	2	1	1	1	2	1
Bradfordoceras	2	3	2	2	2	2	1	2
Loxoceras	2	2	2	?	?	?	?	3
Euloxoceras	3	3	2	1	1	2	2	1

I. Section:
  1. Circular throughout.
  2. Circular to depressed in the adult.
  3. Compressed in the adult.

II. Sutures:
  1. Transverse, straight.
  2. Transverse, sinuous.
  3. Oblique, sinuous.

III. Position of siphuncle:
  1. Central.
  2. Ventrad of center.

IV. Segments of the siphuncle, young stage:
  1. Subcylindrical.
  2. Fusiform.

V. Segments of adult siphuncle:
  1. Subcylindrical.
  2. Pyriform, subglobular.

VI. Internal deposits in siphuncle:
  1. Absent.
  2. Lamellar, continuous.

VII. Internal deposits in camerae:
  1. Circumferential, present.
  2. Absent.

VIII. Range:
  1. Pennsylvanian.
  2. Devonian.
  3. Mississippian.

PSEUDORTHOCERAS Girty 1911

Long slender orthoceracones, the young stage slightly but distinctly curved. Circular in section, except when flattened by distortion during preservation. Test thin and smooth. Sutures straight and transverse. Siphuncle central, small at its passage through the septum but expanded within the camerae. The septal necks are short and strongly recurved. The connecting rings form fusiform segments in the young and subspherical segments in the adult. No area of adnation, the connecting ring terminating at the beginning of the preceding septal neck. Siphuncle often with a continuous lamellar deposit upon the interior, which is normally thicker at the broader part of the siphuncular segments. Camerae with deposits formed circumferentially, attaining the most proximal condition apically, thinning orad but truncated by the adapertural septum.

Pseudorthoceras palmerae Flower and Caster, sp. nov. Pl. 7, fig. 1-3.

Conch orthoceraconic, the apical end slightly curved. Section slightly depressed, but nearly circular, the diameters having the proportions of about nine to ten. Measurements at various points show diameters of 9 and 10 mm., 13.5 and 14.5 mm., 17 and 18.3 mm., and 22.5 and 25 mm.

In a length of 50 mm. the diameters increase from 17.5 and 16 mm. to 24 and 22.3 mm. The apical angle is about 7° dorso-ventrally.

Siphuncle central or subcentral throughout. Where the diameters of the conch are 16 and 17.5 mm., the siphuncle is 1.5 mm. in diameter and is 8 mm. from both dorsum and venter. At this point the septa are 4.5 mm. deep, or one-fourth the dorso-ventral diameter.

Sutures transverse throughout. In a portion of the phragmocone equal to the adapertural dorso-ventral diameter of 11 mm. there are 3.5 camerae; where the diameter is 21 mm., there are four camerae in a space equal to that length.

Siphuncle cyrtochoanitic, known only in a portion the adapertural diameter of which is 7 mm. Brim and septal neck subequal, the septal neck extending less than one-sixteenth the distance to the preceding septum. Connecting rings subcylindrical, contracting strongly at both extremities, and slightly broader adaperturally than adapically. The interior appears to be coated with a continuous lamellar deposit which is uniform throughout and is not sufficient to appreciably diminish the interior diameter of the siphuncle. Within the camerae are to be found good circumferential deposits, almost identical with those figured by Miller, Dunbar and Condra[25] for *Pseudorthoceras knoxense*.

Living chamber with a length equal to two and one-half times the dorso-ventral diameter at the last septum, the length in the holotype being 53 mm., where the dorso-ventral diameter at the base is 21 mm. 31 mm. from the base of the living chamber the diameter is 26 mm. Just beyond this point there is a prominent constriction of the interior, so that 38 mm. from the base the diameter of the internal mold has decreased to 21 mm. Enlargement from there on is gradual. 52 mm. from the base the diameter has increased to 24 mm.

---

[25] *Loc. cit.*, pl. 1, fig. 6.

Aperture not preserved. There is no evidence of a hypnonomic sinus. Test less than .5 mm. in thickness except at the constriction, where the thickness increases to 2 mm., so that the exterior of the shell does not show the constriction.

The surface presents a polished appearance and shows very fine transverse lines of growth under a lens. These are not at all undulate.

Discussion.—This species is referred to *Pseudorthoceras* with some doubt. The siphuncle appears to be slightly more tubular and a bit narrower than in *P. knoxense*, and the condition of the siphuncle in the mature portion is as yet unknown. The type is unique. This was referred to *Pseudorthoceras* on the basis of the transverse sutures, the central siphuncle, the Pseudorthoceratoid condition of the interior of the camerae, and in particular, on the basis of the very similar organic deposits.

Type.—Holotype, Armstrong Collection, No. 896, Antioch College, Yellow Springs, Ohio.

Occurrence.—Panama horizon, Venango stage, Upper Devonian, Reynolds Quarry, Erie County, Pennsylvania.

BRADFORDOCERAS Flower and Caster, gen. nov.

Genotype.—*Bradfordoceras transversum* Flower and Caster, sp. nov.

Conch long, straight, gradually expanded orad, but with a constriction near the mature aperture. Apical extremity unknown, possibly slightly curved as in *Pseudorthoceras* Miller, Dunbar and Condra[26]. Section slightly depressed throughout. Sutures oblique, descending orad on the dorsum, slightly sinuous at the sides, sometimes with definite lobes and saddles.

---

[26] *Loc. cit.*, p. 77-85, pl. 1, fig. 4-9.

Siphuncle slightly eccentric, being located about half way between the center of the conch and the venter; cyrtochoanitic. The segments are pyriform or nearly subspherical in the more mature part of the conch, the width being equal to the depth of the camerae. The rate of expansion of the connecting ring is greater on the adoral extremity than on the adapical end. The septal necks are one-fourth to one-fifth the depth of the camerae in length, and are more than twice the length of the brims. The connecting ring expands outward abruptly from the neck, contracts more gradually at the apical end, and terminates at the turn of the septal neck of the preceding septum with no area of adnation. The connecting ring is not in contact with the adoral septum.

Continuous lamellar deposits line the siphuncle, though these are sometimes irregular in the more convex portions of the siphuncle, appearing as though pulled away from the wall and broken. They are uniform in thickness throughout, not thickened at the broader parts of the siphuncle as in *Pseudorthoceras* as shown by Miller, Dunbar and Condra[9]. The camerae contain deposits formed against the concave adapertural side of the septum which are somewhat different from those of *Pseudorthoceras.* The deposit was absent in all of the specimens sectioned, but its margin was preserved as a band of iron oxide. The deposit had apparently been replaced histometabasically by calcite, but the remainder of the camera was lined with what appeared to be a lamellar deposit, but which more probably represents the edge of the empty cavity which was filled in like a geode.

The pseudosepta, representing the margin of the circumferential deposit, attain the adoral septum near the wall of the conch. On the dorsum the pseudosepta descend to a level half way between the camerae, and there extend parallel to the septa to a point two-thirds of the distance from the dorsal wall to the siphuncle. Here the pseudoseptum turns sinuately apicad, and turning again extends parallel to the septum, this time very close to the preceding septum, terminating apparently at the apical end of the connecting ring. On the venter the deposit is thicker, occupying four-fifths of the depth of the camera instead of one-half. This condition continues to a point slightly more than two-thirds the distance from the ventral wall to the siphuncle. From there the pseudoseptum turns apicad to the preceding septum. In some instances it appears to end there, while in others it can be traced extending near or adjacent to the preceding septum and thence to the siphuncle wall.

The mature conch shows a variable form of contraction near the aperture. The aperture bears a broad but distinct hyponomic sinus. The surface markings of the genotype are unknown. *B. hector* shows, according to Hall, fine lines of growth. Specimens of *B. consortale* show similar lines of growth.

The preceding table shows the relation of *Bradfordoceras* to the other genera of the Pseudorthoceratidae. *Bradfordoceras* agrees with *Pseudorthoceras* in having pyriform siphuncular segments, internal deposits in the camerae and in the siphuncle. It differs from *Pseudorthoceras* in having the siphuncle eccentric, the sutures oblique and sinuous, and internal deposits in the siphuncle of uniform width throughout. *Euloxoceras* which has sinus oblique septa and an eccentric siphuncle might be mistaken for *Bradfordoceras,* but in *Euloxoceras* the section is compressed instead of depressed, and the connecting rings are subcylindrical and without internal deposits.

Bradfordoceras is confined to the upper Devonian so far as is known. Further, most of the species are from the Venango. Of previously described forms, Hall's *Cyrtoceras?hector, Orthoceras consortale* and *Orthoceras conchleatum* seem to belong here. *O. conchleatum* was preoccupied, and the species was changed to *O. warrenense* by S. A. Miller[27]. These species will be discussed below.

Bradfordoceras transversum Flower and Caster, sp. nov.
Pl. 3, fig. 1-5; Pl. 4, fig. 1; Pl. 5, fig. 1; Pl. 6, fig. 3; Pl. 8, fig. 3-4.

Orthoceracones of depressed section in the adult, slightly more circular in the young. The apical extremity is unknown. Diameters at various points reveal the following relations:

---

[27] Miller, S. A. North American Geology and Paleontology, Cincinnati, 1889, p. 452.

dorso-ventral	transverse
11 mm.	13 mm.
22 mm.	29 mm.
46 mm.	60 mm.

The rate of expansion is slight, being 1 mm. in a length of 10 mm. in the dorso-ventral diameter of the holotype, in a portion the adapical diameter of which is 22 mm. In a length equal to the adapical diameter of 50 mm., the transverse diameter increases by 13 mm.

The camerae are relatively shallow, scarcely increasing in depth throughout the length of the conch. There are 5.5 camerae in a length equal to an adapertural diameter of 22 mm., and 6.5 camerae in a length equal to an adapertural diameter of 38 mm.

The sutures are oblique and only very slightly sinuous, the curvature being greatest at the sides while over the greater part of the venter and dorsum in a normal specimen the sutures are transverse. They slant adaperturally on the dorsum.

Septa oblique, the depth being 7 mm. from the dorsal part of the suture, 4.4 mm. from the suture at the point of greatest transverse diameter, and 1.5 mm. from the ventral part of the suture in a specimen in which the diameters at this point are 22 mm. and 29 mm. There are no lateral lobes as in *B. sinuosum.*

The siphuncle is nummuloidal in section. Where the diameter of the face sectioned is 22 mm. the siphuncle is 2 mm. in diameter at its passage through the septum. This face is slightly inclined to the dorso-ventral diameter, which is estimated at this point as 20 mm. The siphuncle is nummuloidal, expanding within the camerae to twice the diameter at the passage through the septum, or to a width equal to the depth of the camera. The shape is pyriform, the expansion being more abrupt orad than apicad.

The septal neck is one-fifth the depth of the camera, and twice the length of the brim. The connecting ring originates at the transverse brim, curves apicad, contracting gently in the apical third, so that its tip touches the preceding septum just within the turn of the septal neck with no perceptible area of adnation.

All of the three specimens sectioned show good evidence of a continuous lamellar deposit lining the siphuncle. This is uniform in thickness throughout, and is placed close against the wall of the siphuncle at the passage through the septa, but is often irregular in the expanded portion, being sometimes angular, as though broken and pulled away from the wall in places, (pl. 3, fig. 1).

Traces of internal deposits are to be found within the camerae of all the specimens sectioned. As was pointed out above, under the discussion of the genus, the deposits are absent, being completely replaced by calcite in our material. The margin of the deposits is represented by a brown band of iron oxide. On the dorsal side these lines, or pseudosepta, originate on the convex side of the adoral septum which appears narrowly to truncate the region of the circumferential deposit. The lines descend to a point half way between the septa, where they turn and run nearly parallel to the septa for about two-thirds the distance to the wall of the siphuncle. There the line curves apicad, and after another turn, runs parallel to the septa again, this time being either adjacent to the preceding septum or narrowly separated from it, (pl. 3, fig. 4). This structure terminates at the siphuncle. In some of the sections there can be seen a white deposit which appears to be lamellose, which runs parallel to the band of iron oxide, adjacent to it on the oral side. This continues over the outside of the siphuncle, and traces of it can be made out on the convex side of the adoral septum. It would appear that this is not of organic origin, but instead is attributable to the filling in of the cavity of the camerae as though it were a geode.

The structure on the ventral side is somewhat different. The contact of the pseudoseptum and the convex side of the adoral septum has not been observed, this part of all of the specimens sectioned being destroyed. When first seen, the pseudoseptum runs parallel to the true septa close to the adoral one. It continues thus to a point three-fourths of the distance from the wall of the conch to the ventral wall of the siphuncle. Here it curves to a nearly vertical position, in which it meets the preceding septum, sometimes curving slightly proximally, but apparently not attaining the wall of the siphuncle.

The regularity of these deposits throughout is the strongest argument for their organic origin. There is a general similarity to the circumferential deposits found by Miller, Dunbar and Condra[28] in *Pseudorthoceras knoxense*, with the structures described in this paper in *Pseudorthoceras? palmerae*, and with structures found by Flower[29], in certain cephalopods from the Cherry Valley limestone of Hamilton age.

The thickness of the test and the surface markings are unknown. Closely related forms show evidence of transverse rather undulate lines of growth. The living chamber is long, an aseptate portion preserving the aperture being 156 mm. in length, with a transverse diameter at the base of 45 mm., (pl. 4, fig. 1). There is a slight constriction near the mature aperture, more prominent laterally than dorso-ventrally. It occurs at a point where the transverse diameter is 60 to 64 mm., varying somewhat in individuals. The aperture bears a broad shallow hyponomic sinus situated between two lateral crests, which grade dorsally into a low broad sinus which makes up over half of the total circumference of the aperture.

Discussion.—This is the most abundant species in the sandstone at Lewis Run, and is one which has been found in all conditions or distortion. A normal specimen can be distinguished by the shallow camerae, the absence of sinuate patterns on the sutures, and the gradual rate of expansion. Specimens which are compressed or depressed by the weight of the sediments were often so distorted that undulate suture patterns resulted. These could be recognized as abnormal by their asymmetry. Such compressed specimens are shown in pl. 5, fig. 1, and in pl. 8, fig. 3-4.

Types.—Holotype, Pal. Res. Inst., No. 5014.
Paratypes, Pal. Res. Inst., No. 5015-5023, and Acad. Nat. Sci. Phila., Second Pa. Geol. Surv. Collection No. 9602.

Occurrence.—The Lewis Run sandstone member of the Venango stage of the Upper Devonian, Lewis Run, brick shale quarry, Lewis Run, Pa., and in the Salamanca sandstones of northern Pennsylvania. The exact locality of the specimen in the collection of the Academy of Natural Sciences of Philadelphia is unknown, but on the basis of lithology and familiarity with the region it would appear to be from near the horizon of the Salamanca conglomerate, (Millers sandstone). F. A. Randall[30] says in this regard: "Yellow ss. *Orthoceras*, Hill North of Warren, shales underlying a flag sandstone 150 ft. to 220 ft. below the SubOlean ss." (Knapp).

---

[28] *Loc. cit.*, p. 81-85, pl. 1, fig. 4-9.

[29] Research in progress, 1935.

This species is probably rather widespread throughout the Venango. In addition, there is a portion of an adult living chamber from the vicinity of Warren, Pa., in the collection of the Warren High School. A number of large very badly depressed specimens from the Chadakoin from Bradford, Pa., in the collection of the authors appear to be conspecific with *B. transversum.*

Bradfordoceras multicameratum Flower and Caster, sp. nov. Pl. 7, fig. 6.

This species is known from one rather imperfectly preserved, compressed specimen. The section was probably slightly depressed. The holotype is compressed, as is shown by the form of the sutures which form saddles on the two broader surfaces and lobes at the sides, that on the left of the specimen, as it is oriented in pl. 7, fig. 6, being deeper than that on the right, and presumably representing the ventral side.

The holotype shows the following relative diameters at the various regions: 21.5 and 33 mm.; 28 and 39 mm., at the last septum, and 35 and 47 mm. at the aperture, which is 51 mm. beyond the last septum. The first and second pairs of measurements were 35 mm. apart.

The condition of the septa, the position and structure of the siphuncle are unknown. The condition of the sutures has been described above. Comparison with compressed specimens of *B. transversum* indicates that the saddles are probably not normal.

The camerae are relatively shallow. Where the diameters are 21.5 and 33 mm., the camerae are 3 mm. in depth.

They are 3.5 mm. in depth 12 camerae farther orad. The last camera is slightly gerontic, shortening again to 3 mm.

---

[30] Cat. Geol. Mus., Second Pennsylvania Geol. Surv., Vol. O. part III, Warren County Collection, F. A. Randall, p. 29, 1889.

On the living chamber can be seen transverse rather lamellose lines of growth. The shell is absent, but these marks are impressed upon the internal mold.

The living chamber shows an indication of a very gradual constriction at its termination, which seems not to represent the aperture.

Discussion.—This species can be distinguished from all known forms by the exceedingly shallow camerae, even those of *transversum* being deeper. It is sufficiently distinct to merit description even though much remains to be learned concerning the structure of this species.

Types.—Holotype, No. 934, Randall collection of the Warren High School, Warren, Pennsylvania.

Occurrence.—In a light yellowish sandstone of Salamanca age 3 miles Southwest of Warren, Pennsylvania.

Bradfordoceras consortale (Hall) Pl. 7, fig. 4.

Orthoceras consortale Hall, Paleontology of New York, vol. 7, Cephalopoda, p. 29, pl. 118, fig. 3-5, 1892.

This is a straight orthoceracone with oblique but only slightly sinuous sutures. The section is depressed, the diameters of Hall's type in the adult being 23.5 and 30 mm.

The rate of expansion is gradual and is uniform throughout. The diameter increases from 20 mm. to 25 mm. in a length of 40 mm. on the holotype. In the next 40 mm., the diameter increases to 33.5 mm.

The sutures are evenly spaced, slightly oblique but not sinuous, ascending adaperturally on the venter. The siphuncle is located about one-third of the distance from the center of the conch and the ventral wall. Where the diameters of the conch are 24 and 30.5 mm., the siphuncle is 2 mm. in diameter and is located 7 mm. from the ventral wall and 14 mm. from the dorsal wall. In a slightly earlier stage in a compressed specimen the siphuncle appears to be nearly central. The dorso-ventral diameter here is 22 mm., and the siphuncle is approximately 2 mm. in diameter, 9 mm. from the venter and 10 mm. from the dorsum.

The siphuncle is nummuloidal in section. Where it is 2 mm. at its passage through the septum it expands to 3.2 mm. within the camera. This is slightly less than the expansion of the siphuncle in the genotype, and appears even less on account of the depth of the camerae. No circumferential deposits in the camerae or internal deposits lining the siphuncle are known. The camerae are 5 mm. in depth on the holotype where the transverse diameter is 27 mm. There are four in a length equal to this adapertural diameter. The depth remains unchanged to the last camera, with occasional individual variations of less than .25 mm. At a point 100 mm. farther on, the diameter is 35.5 mm. There are 8 camerae in a length equal to this adapertural diameter.

The septa are shallow and oblique, descending 7 mm. on the dorsum and 2.5 mm. on the venter, in the compressed hypotype.

The length of the living chamber and the characters of the aperture are unknown.

Hall describes the surface markings as irregular lamellose lines of growth making a distinct retral curve on the ventral side, thus indicating the presence of a hyponomic sinus in this species.

Discussion.—This species can be readily recognized by the depth of the camerae, which is 5 mm. from a diameter of 17 mm. to the largest septate portion known; by the oblique but straight or very faintly sinuous sutures, and by the siphuncle, which expands within the camerae to twice the diameter at its passage through the septa as in *N. transversum,* but which is much more slender due to the depth of the camerae. The drawing of the section of this species shown by Hall on his pl. 118, fig. 4, appears to be slightly reduced. It is taken from a part of the same specimen shown in fig. 3 in the same plate.

The hypotype figured in this paper is recognizable by the characters of the sutures and camerae. It is slightly compressed but presents a natural section of a part of the siphuncle at its apical end.

Types.—Holotype, No. 123551, New York State Museum.
Hypotype, No. 931, Randall Collection, Warren High School, Warren, Pennsylvania.

Occurrence.—Holotype, "In a sandstone in the Chemung group at Panama, Chautauqua county," according to Hall. This is presumably the Panama conglomerate.

Hypotype, From the Salamanca conglomerate, 3 miles northeast of Warren, Pennsylvania.

Bradfordoceras ignotum Flower and Caster, sp. nov. Pl. 4, fig. 4.

The phragmacone of this species is unknown. The species is described from an internal mold representing the adapical portion of the living chamber. The section is transversely oval, the dorsum and venter not flattened. The holotype is very slightly distorted. The diameters of the section are 25 and 28 mm. The siphuncle is not preserved, but is probably located between the center and the ventral wall. This species is distinguished from all others by the presence of a very prominent constriction near the base of the living chamber. This occurs just beyond a point where the diameters are 25 and 29 mm. The constricted area is 6 mm. in length, one and one-half times its length from the base of the living chamber in this specimen, and is more pronounced laterally than dorso-ventrally, reducing the transverse diameter to 25 mm. and the dorso-ventral diameter to 24 mm.

Sutures oblique, probably not normally sinuous. The holotype shows a slight asymmetrical ventral lobe which is the result of distortion.

Discussion.—The very prominent constriction separates this from all the other smooth orthoceracones so far known from the Upper Devonian. *B. transversum* possesses a similar constriction, but one that occurs at a much later stage and which is relatively shallow.

Types.—Holotype, Pal. Res. Inst., No. 5028.

Occurrence.—From the Lewis Run sandstone member of the Venango stage of the Upper Devonian, from the Lewis Run brick shale quarry, Lewis Run, Pennsylvania.

Bradfordoceras gomphoides Flower and Caster, sp. nov. Pl. 4, fig. 2-3.

The holotype, the only known representative of the species, consists of a portion of a living chamber and 5 camerae, the last two abbreviated.

The section is depressed, the transverse diameter at the base of the living chamber being 35 mm., where the dorso-ventral diameter is 27 mm. Were the ventral side present, this diameter might be increased to 30 mm. The rate of expansion is 1 mm. in the depth of 3 camerae or in 11 mm.

The sutures are oblique, ascending adaperturally on the dorsal side. There are distinct though shallow lateral lobes, showing a convex adapical curvature both dorsally and ventrally. The dorsal saddle is higher than the ventral saddle. Both are transverse for the greater part of their widths. The first 3 camerae, which are normal, are 3 mm. deep. The next is 1.5 mm. in depth, and the one following is .8 mm. deep.

The elements of the siphuncle are unknown. It is nearly central in position, being located 11 mm. from the dorsum, and 9.5 mm. from the ventral edge of the specimen. It is 2 mm. in diameter.

Discussion.—No younger fragment has been found which can be attributed with certainty to this species, at least from the Lewis Run sandstone. The distance between the sutures is similar to that of *B. transversum,* from which it can be distinguished by the more centrally placed siphuncle and the lateral lobes.

Types.—Holotype, Pal. Res. Inst., No. 5029.

Occurrence.—In the Lewis Run sandstone at Lewis Run, Pennsylvania.

Bradfordoceras sinuosum Flower and Caster, sp. nov.
Pl. 5, fig. 1-4; Pl. 7, fig. 5; Pl. 7, fig. 5.

Cyrtoceras? hector (*pars*) Hall, Paleontology of New York, vol. 5, pt. 2, p. 364, pl. 90, fig. 12-15 (not fig. 11). 1879.

Orthoceraconic forms which have the section circular or nearly so in the young, becoming gradually depressed adaperturally so that at various points the diameters are 23 and 28 mm., 28 and 33 mm., and 32 and 39 mm. respectively.

The rate of expansion is slight as can be seen from the above figures, the dorso-ventral diameter increasing from 23 to 28 mm. in 27 mm., and from 28 to 32 mm. in 33 mm., while the transverse diameter increases from 28 to 33 mm. in 27 mm., and from 33 to 39 mm. in 33 mm.

The sutures in the young are oblique and scarcely sinuous. In the adult there is a distinct suture pattern, (pl. 5, fig. 4), consisting of a low ventral saddle, slight lateral lobes, distinct dorso-lateral saddles, and a very low but distinct mid-dorsal saddle.

There are 5 camerae in a length equal to an adapertural dorso-ventral diameter of 31 mm. In a length of 34 mm. the camerae increase in depth from 5 mm. to 6 mm.

The septa rise 7.5 mm, from the sides where the diameters are 28 and 33 mm., measuring from a point where the conch attains its greatest transverse diameter. The depth is 5 mm. from the ventral part of the suture, and 10 mm. from the mid-dorsal part of the suture.

The siphuncle is situated 10 mm. from the dorsal side and 18 mm. from the ventral side and is about 3 mm. in diameter at this septum. The structure of the siphuncle has not been observed. The thickness of the test and the surface markings have not been observed. The internal mold is without ornamentation.

The condition of the aperture and the length of the living chamber are unknown. The longest living chamber is found on a small, slightly compressed specimen. It is at least one and one-half times the diameter at the last septum where that is 16 mm., (pl. 7, fig. 5).

Discussion.—As is pointed out in the discussion of *Bradfordoceras hector* (Hall), below, the two specimens figured by Hall represent two distinct species. The first one figured we have selected as the lectotype of *B. hector,* and the second becomes a paratype of *Bradfordoceras sinuosum.*

The species is separated from the other orthoceraconic forms by the sinuate sutures of the adult, the distant septa, and the relatively large dorso-ventral diameter.

Types.—Holotype, Pal. Res. Inst., No. 5024.
Paratypes, American Museum of Natural History, No. 4923/1. Pal. Res. Inst., Nos. 5024-5027, 5049; Yale Peabody Museum, No. 13740E.

Occurrence.—Holotype and Pal. Res. Inst. Paratypes 5024-5027 are from the Lewis Run sandstone at Lewis Run, Pa. Hall's type, that of the American Museum of Natural History, is labeled "Chemung, near Olean, N. Y." This is presumably of Conewango age, but may possibly be from the Chadakoin of the upper Conneaut; certainly not from the true Chemung. The Pal. Res. Inst. Paratype No. 5049 is from the Pope Hollow conglomerate member of the Salamanca suite, along the highway at the east end of the Tidioute bridge across the Allegany river, Warren County, Pennsylvania. This species probably ranges throughout the Conewango. It has been found nowhere abundantly.

Bradfordoceras hector (Hall) Pl. 3, fig. 6.

Cyrtoceras? hector Hall, Paleontology of New York, vol. 5, pt. 2, p. 346, pl. 90, fig. 11, (not fig. 12-15), 1879.

Hall's original description of *Cyrtoceras? hector* was unfortunately based upon two specimens which appear not to be conspecific. The first (fig. 11), that upon which his description seems to be mainly based, is an obliquely compressed specimen from Warren, Pennsylvania. Because of the prominent part which this species played in Hall's description, it seems best to designate it as the lectotype of *C.? hector*. It is unfortunate that the present whereabouts of this specimen is unknown.

The second specimen we have considered as a paratype of *B. sinuosum*. It differs in having the camerae much deeper in proportion to the width, and in lacking a gerontic contraction to the aperture.

Description.—(From Hall's figure.) An obliquely compressed specimen, the sutures distorted. The camerae are about 2 mm. deep where the diameter is 28-32 mm. The last camera is definitely gerontic, being one-half the length of the preceding.

The living chamber is incomplete, 27 mm. in length, with a diameter of 33 mm, at the base. At the termination of the specimen there is the beginning of a contraction.

It was presumably from this specimen that Hall described the surface markings. He mentions: "surface marked by fine striae of growth, with a few coarser lamellose lines at the margin of the aperture."

Discussion.—None of the cephalopods from the Lewis Run sandstone appear to be conspecific with *B. hector,* though *B. gomphoides* is quite close. In *B. gomphoides* the camerae are slightly deeper. Among the specimens from the Salamanca horizon there are a number which agree with *B. hector* in possessing contracted camerae and a constriction of the living chamber at an early stage. Some of these are from Warren, Pennsylvania, others are from the Salamanca at the Tidioute bridge. There is slight variation in the depth of the normal camerae, but the gerontic camerae appear at a slightly different stage in almost every specimen. The relationship of these forms is uncertain, and they are described tentatively as variants of *B. hector,* since they are closer to that species than to any other species. These occur in an association with specimens which can be referred to *B. transversum* and to *B. sinuosum.* Chadwick has referred[31a] this species doubtfully to *Cyclostomiceras.*

Type.—Present deposition unknown.

Occurrence.—"Chemung near Warren, Pennsylvania" according to Hall. In modern stratigraphy this would probably be in the lower part of the Venango stage of the Conewango series.

Bradfordoceras hector variant **alpha** new variant Pl. 6, fig. 4.

This is a small slender form, the holotype of which is somewhat depressed. The specimen consists of 10 camerae and a portion of the living chamber. The first six camerae, starting adapically, show the following depths: 2.4 mm., 2.8 mm., 3 mm., 3.8 mm., and 4 mm. The remainder contract rapidly, being 3 mm., 2 mm., 1.5 mm., and 1.3 mm.

The diameter at the adapertural end (transverse), is 14 mm. 7 mm. before this, at the last septum, the diameters are 13.5 and

---

[31a] *Loc. cit.*

10 mm. The adapical end of the specimen, 24 mm. beyond this has a transverse diameter of 11 mm.

7 mm. beyond the last septum there is a very slight constriction of the living chamber. The aperture is unknown. The greatest length of the living chamber shown on the fragment is 16 mm.

Discussion.—The specimen seems to be depressed, the ventral side being preserved. The sutures are all slightly convex adaperturally.

Type.—Yale Peabody Museum, No. 13740 A. The holotype is unique.

Occurrence.—The specimen is labeled "Chemung, Warren, Pa." The horizon is probably the Salamanca conglomerate.

Bradfordoceras hector variant beta new variant Pl. 6, fig. 5, 6, 8.

This variant is based upon three specimens, one consisting of an early part of a phragmacone, one consisting of two undistorted camerae, and one consisting of a very slightly compressed fragment of a part of a living chamber and the 5 adjacent camerae.

Section oval, slightly depressed. The diameters are 16 mm. and 14.4 mm. The siphuncle at this point is 1.7 mm. in diameter and is 7.3 mm. from the dorsum and 6.3 mm. from the venter.

The sutures are slightly oblique, slanting adaperturally on the dorsum. Where the adapertural diameters are 16 and 15 mm., the camerae are 3.6 to 4 mm. in depth, being slightly variable.

The holotype is slightly compressed and one side is destroyed. The transverse diameter is 18 mm. at the base of the septate portion. The camerae, starting adapically, measure 3.8, 4, 3, 2 and .8 mm. In the septate portion, which is 13 mm. in length, the diameter increases from 18 mm. to 21 mm. Only the apical 11 mm. of the living chamber are known. These show no evidence of any constriction, but one probably occurs in the specimen a little farther on.

Types.—Holotype, Yale Peabody Museum, No. 13740 B.
Paratypes, Yale Peabody Museum, No. 13740 C, D.

Occurrence.—"Chemung, Warren, Pa." In modern stratigraphy the horizon is presumably the Salamanca conglomerate suite.

Bradfordoceras hector variant **gamma** new variant Pl. 4, fig. 5.

This is a relatively large variant showing the constriction of the camerae clearly, but with only a very faint indication of a very gradual constriction at the broken adapertural end of the living chamber.

The holotype is depressed, the surface represented in pl. 4, fig. 5 being dorsal. The ventral surface is not preserved. The section is slightly crushed, the relative diameters being 27 mm. and about 19 mm. at the adapical end of the specimen. The transverse diameter increases to 32 mm., 26 mm. orad, at the last septum. The sutures curve slightly adaperturally on the middle of the specimen. The depth of the camerae is about 3 mm. This continues for the first 6 camerae with no perceptible variation. The next camera is 3.2 mm. in depth; the last is 2 mm. in depth. The living chamber is 25 mm. long. The aperture is unknown.

Discussion.—The apparent constriction of the holotype 6 mm. beyond the last septum is due to a break in the shell. This is one of the larger variants, approaching more closely to *B. hector, s.s.*

Type.—Holotype, Pal. Res. Inst., No. 5041. No paratypes are known, the holotype being unique.

Occurrence.—From the Pope Hollow conglomerate member of the Salamanca suite at the east end of the Tidioute bridge across the Allegany River, Warren County, Pennsylvania.

Bradfordoceras hector variant **delta** new variant Pl. 8, fig. 6-8.

This is represented by two specimens. The holotype consists of three camerae and a portion of the living chamber. The paratype represents a slightly later stage of the living chamber.

The holotype is slightly distorted so that the dorso-ventral diameter is inclined about 45° from the apparent dorso-ventral diameter, that is, from the shortest diameter. As a result there is a sinuosity in the suture pattern which is probably not normal The specimen is of interest because the sinuosity is almost identical with that of the lectotype of *B. hector*. The position of the siphuncle is shown on pl. 8, fig. 8. It is 2 mm. in diameter. It is 9 mm. from the apparent ventral side of the conch, 11 from the apparent dorsum, and is 9 mm. from one side and 12 mm. from the other.

The transverse diameter across the adapical end of the holotype is 24.5 mm. The camerae, progressing adorally, measure 3.5 mm., 3 mm., and 2 mm. in depth. The greatest and least diameters across the last septum are 27.5 and 23 mm. The living chamber extends 31 mm. beyond the last septum. 14 mm. beyond the last septum the diameters are 28 and 24 mm. Beyond this point there is a gradual constriction.

The paratype is 41 mm. in length, and is a little more nearly circular in section. The diameters at the base are 27.5 and 26.5 mm. 15 mm. farther, they increase to 29 and 26.5 mm. 6 mm. beyond this, in the middle of the constriction, the diameters are 27.6 and 26 mm. 10 mm. beyond this, at the end of the specimen, the diameters have increased to 28 and 26.5 mm.

Types.—Holotype, Pal. Res. Inst., No. 5039.
Paratype, Pal. Res. Inst., No. 5041.

Occurrence.—In the Pope Hollow conglomerate member of the Salamanca suite, near the Tidioute bridge, Warren County, 'ennsylvania.

Bradfordoceras hector variant **zeta** new variant Pl. 6, fig. 2.

This is a larger form of variant *alpha,* agreeing with that variant in the very slight constriction and the slender form, but possessing the gerontic characters at a later stage.

The specimen consists of a portion of the living chamber and five camerae. The section is slightly distorted. The siphuncle is 1 mm. in diameter, and is 4 mm. from the venter and 11 mm. from the dorsum, recalling the condition of *B. transversum.* At this point the diameters are 15 and 19 mm.

The first three camerae are 3.8 mm. in depth. The fourth measures 2.4 mm., and the last, 1.5 mm. The diameters measured at the region of the lateral part of the last suture are 21 mm. and 18 mm. The living chamber is represented by a fragment 33 mm. in length, not bearing the aperture. 24 mm. from the last septum the diameters are at their greatest, being 22 and 19 mm.

Beyond this there is a gentle constriction, which widens again toward the apertural end of the fragment. It does not decrease the diameters at its middle more than .5 mm.

Types.—Holotype, Randall Collection of the Warren High School, Warren, Pa. The type is not numbered.

Occurrence.—The exact locality is not known The specimen is from a sandstone presumably of Salamanca age from the vicinity of Warren, Pa.

Bradfordoceras hector variant **eta,** new variant Pl. 6, fig. 1.

This is a slightly compressed specimen, superficially resembling *Orthoceras warrenense* Miller[31], from which it differs in the depth of the camerae. The holotype is compressed, and the sutures are oblique over the greater part of the broader surfaces. The holotype consists of a living chamber which retains a portion of the aperture, and a phragmacone containing some thirty odd camerae. The earlier camerae are destroyed partially by weathering. The specimen is about 120 mm. in length. The last seven camerae show depths of 3, 3, 3, 3, 3, 2.5 and 2 mm. respectively. The greater diameter at the base of the first of these is 17.5 mm. At the base of the living chamber, measuring at the most adapertural extension of the last septum, the diameters are 23 and 26 mm. The greater diameter increases to 30 mm. in a length of 12 mm. Beyond this point there is a cessation of expansion which is gerontic. This continues to the aperture which appears to be straight; however only a small lateral portion of it remains.

Types.—Holotype, Pal. Res. Inst., No. 5043.

Occurrence.—Pope Hollow member of the Salamanca suite near the Tidioute bridge across the Allegany River, Warren County, Pennsylvania.

---

[31] Miller, S. A., North American geology and paleontology. Cincinnati, 1889, p. 452.

Superfamily ACTINOSIPHONATA Hyatt

BLASTOCERAS Flower and Caster, gen. nov.

Genotype.—*Blastoceras cylindrostomum* Flower and Caster, sp. nov.

Brevicones in which the curvature is slightly more convex on the venter than on the dorsum and in which the sutures are slightly oblique, slanting adaperturally on the dorsum. The point of greatest gibbosity is located about one-third the distance from the base of the living chamber to the highest point of the aperture, and two-thirds of the distance in the same interval there is an abrupt cessation of contraction, the remainder of the conch being nearly cylindrical or only very slightly contracting.

The aperture is marked by a hyponomic sinus, about twice as broad as deep, which is situated between two ventro-lateral crests. Dorsad of these crests there are dorso-lateral sinuses which are separated by a very low mid-dorsal crest. The characters of the aperture are shown in pl. 6, fig. 10-13. The aperture apparently does not contract as in the Phragmoceratidae and Trimeroceratidae.

The position and structure of the siphuncle have not been observed. The siphuncle is probably near the venter. The thickness and the surface markings of the shell are unknown.

Discussion.—This genus appears to be related to certain of the Oncoceratidae such as *Amphicyrtoceras,* though this is an Ordovician and Silurian group.

It differs from forms previously included in this family in having more prominent crests and sinuses in the aperture. It does not appear to belong to the Phragmoceratidae, Trimeroceratidae or Poterioceratidae, families in which the aperture is definitely contracted.

The dorsal crests appear to be distinctive of the genus. The characters of the aperture are so distinct from those of other known Devonian genera, that we have ventured to base this genus upon *Blastoceras cylindrostomum,* even though its siphuncle and surface markings are unknown.

Blastoceras cyclindrostomum Flower and Caster, sp. nov. Pl. 6, fig. 10-13.

Erect brevicones in which the ventral outline is more convex than the dorsal one over the lower two-thirds of the living chamber and the known camerae. The apical extremity is unknown, and may have had a slight exogastric curvature. The sutures are oblique, rising adaperturally on the dorsum. These are slightly distorted on the holotype so that the highest and lowest points are slightly out of line with the mid-dorsal and mid-ventral regions of the conch.

There are 4 camerae in a length of 12 mm., where the dorso-ventral diameters are 20 and 26 mm. at the extremities of the region measured. In this region the camerae increase in depth from 2.5 mm. to 3 mm. A fifth camera is present in which gerontic contraction is seen. Its depth is about 1.5 mm.

The dorso-ventral diameter across the lowest part of the living chamber is 26 mm. The greatest dorso-ventral diameter is 27 mm. This is situated 6 mm. from the base of the living chamber on the ventral side, and 3 mm. from the base on the dorsal side. 13.5 mm. from the base of the living chamber on the venter, and 12 mm. from it on the dorsum, there is an abrupt cessation of contraction. The dorso-ventral diameter at this point is 21 mm., the outline of both the dorsum and venter being concave at this point.

The aperture consists of a broad hyponomic sinus which is flanked by prominent lateral or ventro-lateral crests. The apices of the crests are 15 mm. apart and the sinus descends 4.5 mm. below the highest part of the crests. The point of greatest transverse diameter of the aperture is situated on the dorsal third of the crests, and is 18 mm. The aperture slopes gradually down from the crests to form dorso-lateral sinuses, which are 4 mm. below the apices of the crests. These sinuses are separated by a low mid-dorsal crest which rises 1.5 mm.

The thickness of the test and the surface markings are unknown.

The position and structure of the siphuncle are unknown. It is probable that the siphuncle when found will prove to be near the ventral side of the conch, and the form is certainly cyrtochoantic.

Discussion.—The mid-dorsal crest is a character which will separate this form from all other cephalopods of the Upper Devonian which are known at the present. The cylindrical oral condition is also characteristic.

The holotype is only slightly distorted, the distortion taking the form of slightly oblique compression and resulting in a distortion of the sutures so that the lowest point is slightly to one side of the mid-ventral region. The same distortion has resulted in a compressed appearance which is probably not normal, and may have increased the normal dorso-ventral diameters slightly throughout.

Types.—Holotype, Pal. Res. Inst., No. 5052.

Occurrence.—In the Lewis Run sandstone member of the Venango stage of the Upper Devonian, at the Lewis Run brick shale quarry, Lewis Run, Pennsylvania.

ANGLICORNUS Flower and Caster, gen. nov.

Genotype.—*Anglicornus anneliesae* sp. nov.

Conch erect, the dorsal outline more convex than the ventral one over the greater part of the living chamber and the adjacent camerae. The apical extremity is unknown, but it may be assumed from the slight and uniform convexity of the ventral side that at the apex there would be a slight exogastric curvature, and as a consequence the dorsal outline would be slightly concave.

Point of greatest gibbosity midway between the last septum and the dorsal part of the aperture, and near the base of the hyponomic sinus on the ventral aperture. Just below the aperture there is a slight flaring or reversal of curvature.

The aperture bears a broad hyponomic sinus expanding gradually toward the main aperture. On either side of the sinus the margin rises to ventro-lateral crests, which are only slightly higher than the dorsal part of the aperture. The remainder of the aperture is uniformly transversely elliptical. The apertural characters are shown in pl. 6, fig. 14, 15.

Siphuncle ventral, in contact with the wall of the conch and exposed along the ventral side in the internal mold. Its elements are fusiform, definitely expanded between the septa but not as broad as the depth of the camerae. There is no trace of actinosiphonate structure so far as is known.

Discussion.—The flaring condition of the simple aperture and the ventral siphuncle will distinguish this from the other breviconic genera. No other Devonian forms are known which can definitely be referred to this genus than the two mentioned below, though further study of some of the little known gomphoceroids of the Schoharie grit may reveal other related species.

Anglicornus anneliesae Flower and Caster, sp. nov. Pl. 6, fig. 14-15.

Section circular or very slightly compressed, the one specimen upon which this species is based being slightly distorted by oblique compression.

Point of greatest gibbosity located midway up the living chamber, where both diameters are 13 mm. Ventral outline very slightly and uniformly convex, with only a slight suggestion of reversal of curvature at the base of the hyponomic sinus. Dorsal outline more gibbous along the living chamber, definitely contracting two-thirds of the distance toward the aperture, beyond which there is a slight but noticeable expansion.

Aperture with a broad hyponomic sinus which expands gradually toward the main aperture and flanked by ventro-lateral crests which rise 9 mm. from the base of the sinus. The holotype is distorted so that on the left side of the specimen there appears to be a lateral sinus behind the crest, while the other side is even. The dorsal part of the aperture descends very slightly from the crests and seems to be even in outline and slightly transverse with the greatest width just dorsad of the highest part of the crests.

Normal camerae 3.5 mm. in depth where the diameter is 18 mm., increasing to 4 mm. where the diameter is 22 mm. In the holotype there are 3 camerae in a space of 11 mm. in which the transverse diameters increase from 17 to 23 mm. The last two camerae, just beyond this region, are contracted, the first being 2.5 mm. in depth and the second 1.25 mm. At the termination of this camera, which is also the base of the living chamber, the transverse diameter is 26 mm.

The sutures are normally transverse and straight. On the holotype they are oblique owing to distortion, the pressure being directed through the right side of the aperture and through the left side of the more apical camerae.

Septa shallow, depth 3 mm. where the diameter is about 25 mm. Siphuncle ventral in position, often exposed on the internal mold. It is 1.75 mm. at its passage through the septa where the transverse diameter is 23 mm., and expands within the camerae to a width of 2.25 mm. where the depth of the camera is 4 mm. No trace of actinosiphonate structure has been observed.

Discussion.—The relatively broad section and the late appearance of contraction as well as the slightly flaring aperture will distinguish this from *Blastoceras cylindrostomum,* the only other brevicone so far known from the Lewis Run. *Anglicornus anneliesae* may be distinguished from *A. nasutum* by the relatively deeper hyponomic sinus and the larger size.

Types.—Holotype, Pal. Res. Inst., No. 5050.
Paratype, Pal. Res. Inst., No. 5051.

Occurrence.—In the Lewis Run Sandstone of the Venango stage, at Lewis Run brick quarry, Lewis Run, Pennsylvania, and in the Pope Hollow conglomerate member of the Salamanca suite, along the highway, east of the Tidioute bridge across the Allegany River, Warren County, Pennsylvania.

Anglicornus nasutum (Hall)

Hall, James. Paleontology of New York, vol. 7, Cephalopoda, p. 121, pl. 120, fig. 5-7. 1888.

This species closely resembles *A. anneliesae,* but the proportions and dimensions differ sufficiently to insure their being specifically distinct.

In *A. nasutum* the normal adult camera is 2.6 mm. in depth, and gerontic contraction begins where the transverse diameter of the conch is 22. mm., the last two camerae being 2 mm. deep. The point of greatest gibbosity is nearer the base of the living chamber than the aperture, about one-third the way up, or 7 mm. from the base. The greatest transverse diameter is 26 mm.

The aperture differs only in having a more shallow hyponomic sinus. In *A. anneliesae* the sinus is 8-9 mm. deep and is situated between crests which are about 25 mm. apart. In *A. nasutum* the crests are about 12 mm. apart and the sinus is only 3 mm. deep.

Types.—Holotype, New York State Museum, No. 1293/1.

INCERTAE SEDIS

Orthoceras? sp? Pl. 6, fig. 9.

This orthoceroid of undetermined affinities is represented by an external and internal mold of a portion of a living chamber, presumably the dorsal side. The last septum is not preserved. The fragment is 38 mm. in length, and increases in width from 4 to 7 mm. in that length. It appears to be slightly depressed. Traces of colour bands can be seen on both the internal and external mold, being clearer on the external mold. These consist of concentric transverse bands, descending very slightly adapically on the middle of the dorsum. At the sides the bands are a little less than .3 mm. in width, but at the middle of the specimen they widen to 1 mm., sometimes a little more, being rather variable. The markings are narrower and closer together at the adapical end. At the apical end the bands are .6 mm. in diameter at the middle, and the light space between is 1 mm. It is noted that 26 mm. farther, the bands attain a width of 1.5 mm., and the interspace is about equal to this in width.

Discussion.—This living chamber belongs to a species distinct from any thus far described from the Conewango, as can be seen from the very gradual rate of expansion which suggests a bactriticone rather than a normal orthoceracone. It is highly probable that it represents a distinct genus, for both *Bradfordoceras* and *Pseudorthoceras* with which it must be compared are at least normally rapidly expanding.

Types.—Illustrated specimen is No. 5053 in the Collection of the Paleontological Research Institution.

Occurrence.—In the Pope Hollow conglomerate member of the Salamanca suite of the Conewango, along the highway at the east end of the Tidioute bridge across the Allegany River, Warren County, Pennsylvania.

AMMONOIDEA

Family GLYPHIOCERATIDAE Hyatt

Paralegoceras? milleri Flower and Caster, sp. nov. Pl. 8, fig. 1-2.

This is a closely coiled ammonite the umbilicus of which is closed or only narrowly open in the adult. The section of the whorl is compressed. The point of greatest diameter is 35 mm. from the umbilical shoulder where the dorso-ventral diameter is 48 mm. Only the right side of the specimen is preserved, and it is impossible to determine the transverse diameter at this point. It appears to be about three-eighths of the dorso-ventral diameter. The dorso-ventral diameter increases from 44 to 52 mm. in a revolution of about 90° in the most mature part known. The circumference of this area, measured along the ventral side of the conch, is about 70 mm.

The greatest depth of the camerae, along the venter, is 21 mm., where the dorso-ventral adapertural diameter is 48 mm. On the umbilical shoulder the camerae are about 2 mm. in depth.

The sutures are shown in pl. 8, fig. 2. The dorsal sutures are unknown. Three lateral saddles are present. The most dorsal of these is broad and low, occupying nearly half of the dorso-ventral diameter of the whorl. The middle one is well rounded, slightly expanding anteriorly. This expansion is slightly greater than is shown by fig. 2, pl. 8. It height is to its width as four is to three. The ventro-lateral lobe is very slightly broader, and does not expand orally.

There is an umbilical lobe, a mid-lateral lobe which is subacute, and a ventro-lateral lobe which is evenly rounded. The mid-ventral lobe is slightly shallower than the others, and is rounded and simple. The holotype fragment bears a portion of the living chamber and five sutures, the first one incomplete.

The test is not preserved. There is no evidence upon the interior of any of the surface markings.

The dorsal part of the whorl and the extent of the impressed zone are unknown.

Discussion.—This species is placed in *Paralegoceras* because of the similarity of the sutures, so far as they are known, to those of *Paralegoceras iowense* Meek and Worthen as shown by Hyatt[32], and because the involute condition of the whorl is consistent with conditions already known in that genus. *Paralegoceras* was formerly known only from the Mississippian to the Permian. *Gastrioceras,* which is known from the Devonian, is somewhat similar, but it lacks the umbilical lobe, and is evolute. When the dorsal sutures of *Paralegoceras milleri* are known, it may prove to be generically distinct from *Paralegoceras.* The distinguishing specific characters are to be found in the very broad dorso-lateral saddle and the slight inflation of the mid-ventral saddle, together with the subacute lateral lobe and the rounded ventro-lateral lobe.

Types.—Holotype, In the E. J. Armstrong Collection, Antioch College, Yellow Springs, Ohio.

Occurrence.—The specimen is labeled "Chemung. Howard quarry, Erie County, Pa." The horizon is probably Lower Conewango, near the Panama horizon.

---

[32] Hyatt, Alpheus, The Carboniferous Ammonoids of America, Monographs of the United States Geol. Survey, Vol. 42, p. 100, pl. 4, fig. 12-14; pl. 9, fig. 4-7. 1903.

EXPLANATION OF PLATES

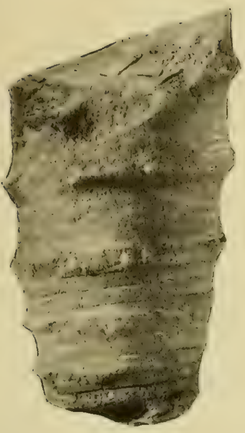
(All figures approximately natural size unless otherwise indicated)

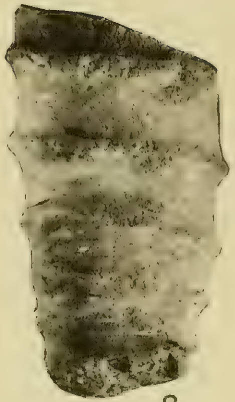
PLATE I

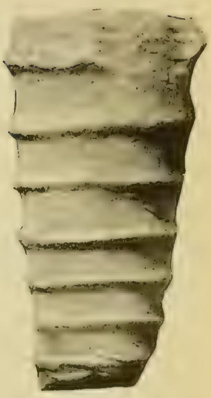
Plates furnished by the authors

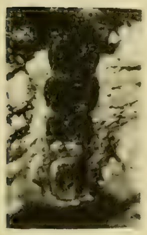
EXPLANATION OF PLATE 1

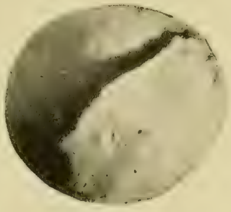
FIGURES		PAGE
	Neocycloceras obliquum Flower and Caster, sp. nov.	16
1.	Holotype. Ventral aspect. Pal. Res. Inst., No. 5000. *Lewis Run sandstone, Lewis Run, Pa.*	
2.	Dorsal aspect of the same specimen.	
3.	Paratype. Showing very regular and even annuli in a compressed specimen. Pal. Res. Inst., No. 5008. *Lewis Run sandstone, Lewis Run, Pa.*	
4.	Paratype. Longitudinal section showing siphuncle. Photographed from a thick section. Pal. Res. Inst., No. 5003. *Lewis Run sandstone, Lewis Run, Pa.*	
5.	Paratype. Adapical aspect showing a nearly normal section and the position of the siphuncle. Pal. Res. Inst., No. 5004. *Lewis Run sandstone, Lewis Run, Pa.*	
6.	Lateral aspect of the same specimen showing the depth of the septum and the oblique suture.	
7.	Paratype. Younger stage showing sutures and annuli. Pal. Res. Inst., No. 5002. *Lewis Run sandstone, Lewis Run, Pa.*	
8.	Paratype. Youngest known stage of the species. Pal. Res. Inst., No. 5001. *Lewis Run sandstone, Lewis Run, Pa.*	
9.	Paratype. Fragment showing extreme variation in the depth of the camerae. Pal. Res. Inst., No. 5005. *Lewis Run sandstone, Lewis Run, Pa.*	
10.	Paratype. A large fragment showing sutures. Dorso-lateral aspect. Pal. Res. Inst., No. 5006.	

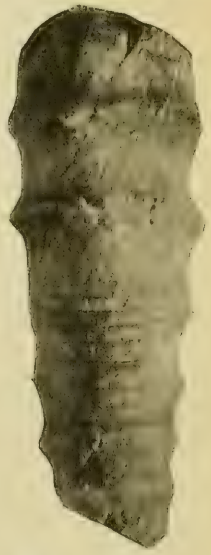

1

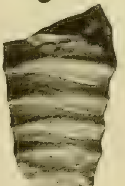

2

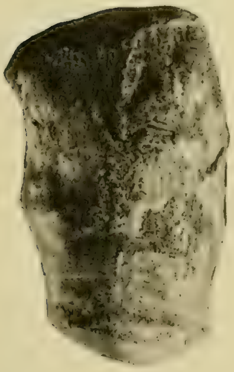

3

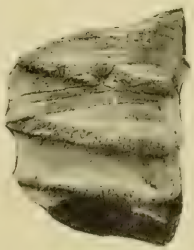

4


5


10


7


6


9

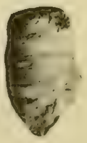

8

PLATE II

EXPLANATION OF PLATE 2

FIGURES PAGE

1. **Neocycloceras obliquum** Flower and Caster, sp. nov. 16
Paratype. Pal. Res. Inst., No. 5007.
Lewis Run sandstone, Lewis Run, Pa.

2. **Neocycloceras obliquum** var. **geronticum** Flower and Caster, nov. var. 18
Holotype. Pal. Res. Inst., No. 5007.
Lewis Run sandstone, Lewis Run, Pa.

3. **Neocycloceras cadwaladeri** Flower and Caster, sp. nov. 22
Holotype. Acad. Nat. Sci. Phila., No. 9425.
Presumably Salamanca conglomerate, Warren, Pa.

4. **Neocycloceras harrisi** Flower and Caster, sp. nov. 19
Holotype. Enlarged about two and one-half times to show the surface markings. Pal. Res. Inst., No. 5030.
Pope Hollow conglomerate (Salamanca), Tidioute, Pa.

5. **Neocycloceras harrisi** Flower and Caster, sp. nov. 19
Same specimen, natural size.

6. **Neocycloceras lilianae** Flower and Caster, sp. nov. 21
Paratype. Pal. Res. Inst., No. 5032.
Pope Hollow conglomerate, Tidioute, Pa.

7. **Neocycloceras harrisi** Flower and Caster, sp. nov. 19
Paratype showing incipient annuli. Pal. Res. Inst., No. 5033.
Pope Hollow conglomerate, Tidioute, Pa.

8. **Neocycloceras harrisi** Flower and Caster, sp. nov. 19
Paratype. Early stage. Pal. Res. Inst., No. 5037.
Pope Hollow conglomerate, Tidioute, Pa.

9. **Neocycloceras harrisi** Flower and Caster, sp. nov. 19
Paratype. Earliest known stage. Pal. Res. Inst., No. 5036.
Pope Hollow conglomerate, Tidioute, Pa.

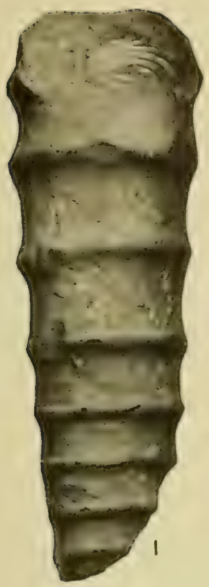
10. **Neocycloceras lilianae** Flower and Caster, sp. nov. 21
Holotype. Showing surface markings, aperture and hyponomic sinus. Ventral aspect. Pal. Res. Inst., No. 5031.
Pope Hollow conglomerate, Tidioute, Pa.

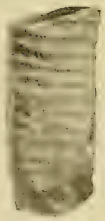
11. **Neocycloceras lilianae** Flower and Caster, sp. nov. 21
Enlargement of a portion of the holotype. About two and one-half times natural size.

12. **Carlloceras garlandensis** Flower and Caster, sp. nov. 25
Holotype. Lateral aspect. Acad. Nat. Sci. Phila., No. 9632.
Salamanca conglomerate, Garland, Pa.

13. **Carlloceras garlandensis** Flower and Caster, sp. nov. 25
Projection of the external part of the suture of the same specimen. The extermination is at the umbilical angles.

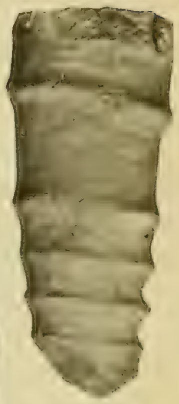
14. **Carlloceras garlandensis** Flower and Caster, sp. nov. 25
Adapical aspect of the same specimen showing the impressed zone and the "false siphuncle".


1


3

8

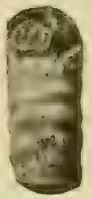
7


2

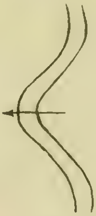
9

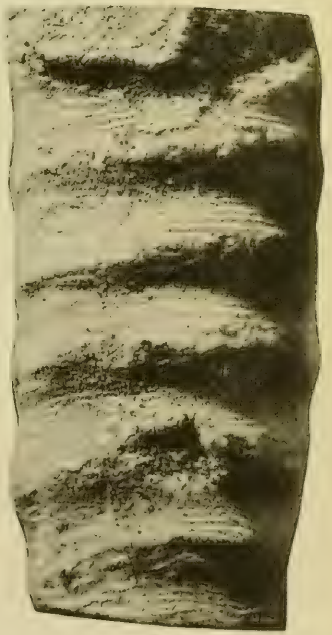
10

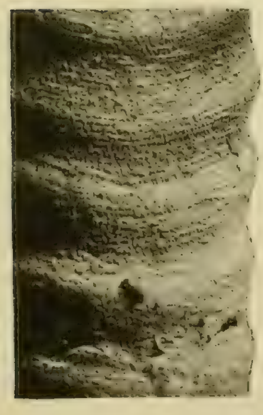
6


5

12


13


4


11

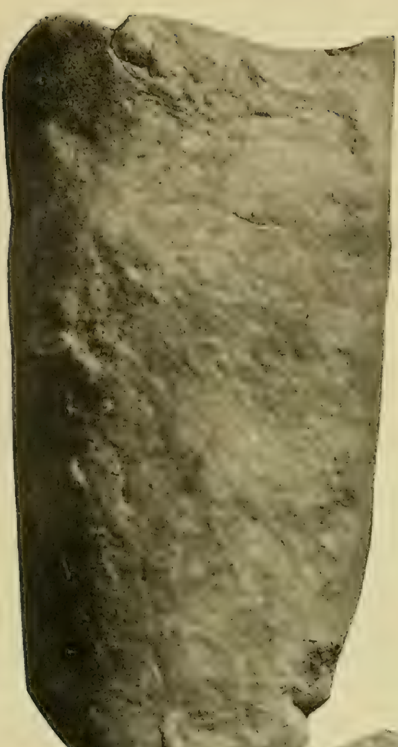
14

PLATE III

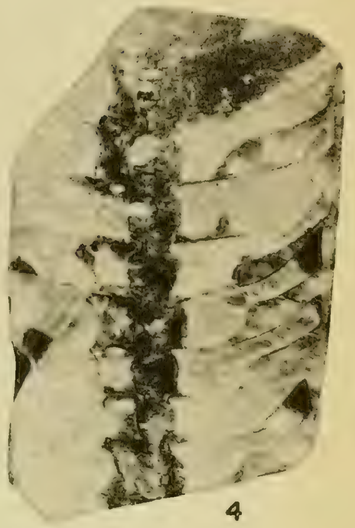
EXPLANATION OF PLATE 3

FIGURES PAGE

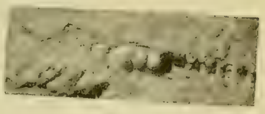
1. **Bradfordoceras transversum** Flower and Caster, sp. nov. 34
   Holotype. A slightly oblique, nearly dorso-ventral section showing the siphuncle, internal deposits, and traces of the pseudosepta. Pal. Res. Inst., No. 5014.
   Lewis Run sandstone, Lewis Run, Pa.
2. **Bradfordoceras transversum** Flower and Caster, sp. nov. 34
   Holotype. A lateral aspect of another portion of the same specimen, showing the depth of the septum and the lateral condition of the sutures.
3. **Bradfordoceras transversum** Flower and Caster, sp. nov. 34
   Holotype. An adapical aspect of the same fragment as that shown in fig. 2, showing the section and the position of the siphuncle.
4. **Bradfordoceras transversum** Flower and Caster, sp. nov. 34
   Paratype. A nearly dorso-ventral section of another specimen showing well preserved dorsal pseudosepta. Pal. Res. Inst., No. 5023. x 2½.
   Lewis Run sandstone, Lewis Run, Pa.
5. **Bradfordoceras transversum** Flower and Caster, sp. nov. 34
   Paratype. Large aperture and a portion of the living chamber, showing the hyponomic sinus, the lateral crests, and a trace of the constriction. Pal. Res. Inst., No. 5021.
   Lewis Run sandstone, Lewis Run, Pa.
6. **Bradfordoceras hector** variant ? 44
   A natural longitudinal section showing the siphuncle.
   Pope Hollow conglomerate, Tidioute, Pa.



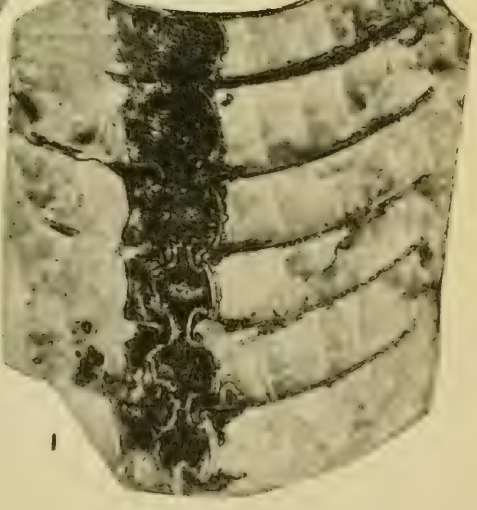
5



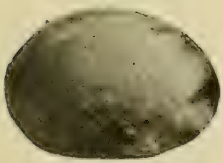
4



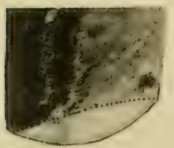
6



1



3



2

PLATE IV

EXPLANATION OF PLATE 4

FIGURES PAGE

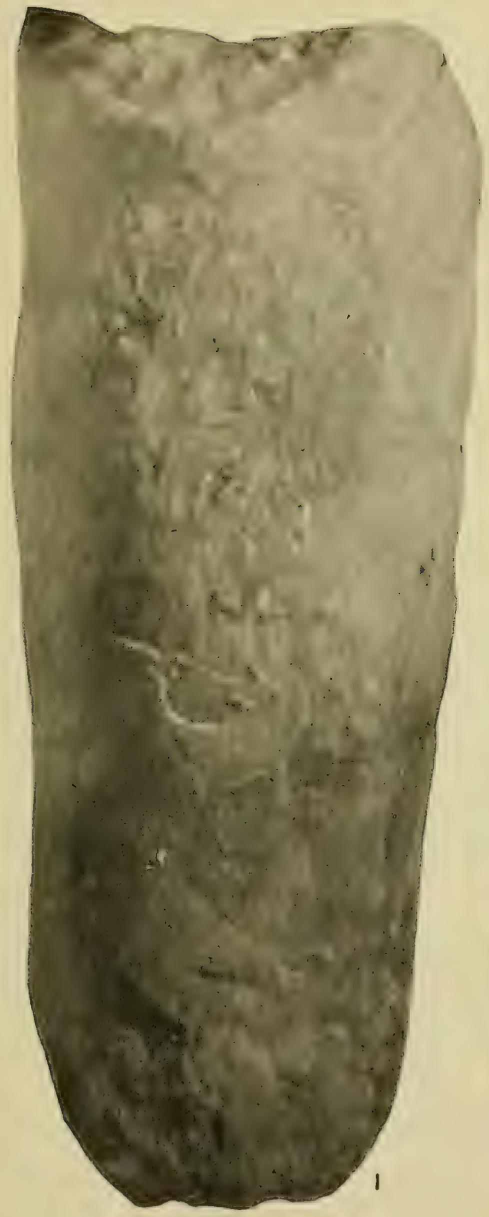
1. **Bradfordoceras transversum** Flower and Caster, sp. nov. 34
Mature aperture showing constriction and hyponomic sinus.
Pal. Res. Inst., No. 5017.
Lewis Run sandstone, Lewis Run, Pa.

2. **Bradfordoceras gomphoides** Flower and Caster, sp. nov. 42
Holotype. Dorsal aspect. Pal. Res. Inst., No. 5029.
Lewis Run sandstone, Lewis Run, Pa.

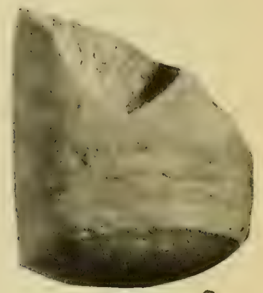
3. **Bradfordoceras gomphoides** Flower and Caster, sp. nov. 42
Adapical aspect showing septum and position of siphuncle.
Same specimen as fig. 2.

4. **Bradfordoceras ignotum** Flower and Caster, sp. nov. 41
Holotype. Pal. Res. Inst., No. 5028.
Lewis Run sandstone, Lewis Run, Pa.

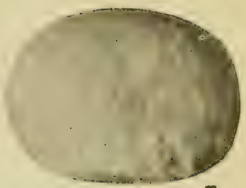
5. **Bradfordoceras hector** variant **gamma,** new variant 47
Holotype. Dorsal aspect of a slightly depressed specimen.
Pal. Res. Inst., No. 5041.
Pope Hollow conglomerate, Tidioute, Pa.



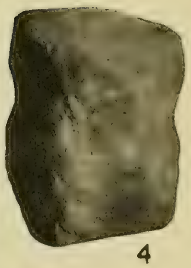
1



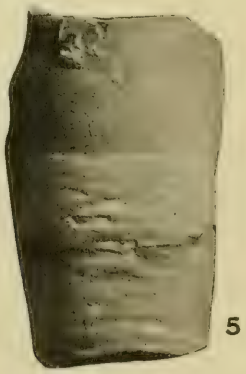
2



3



4

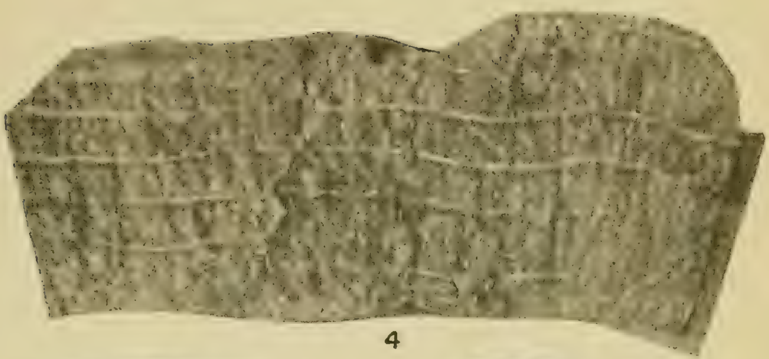


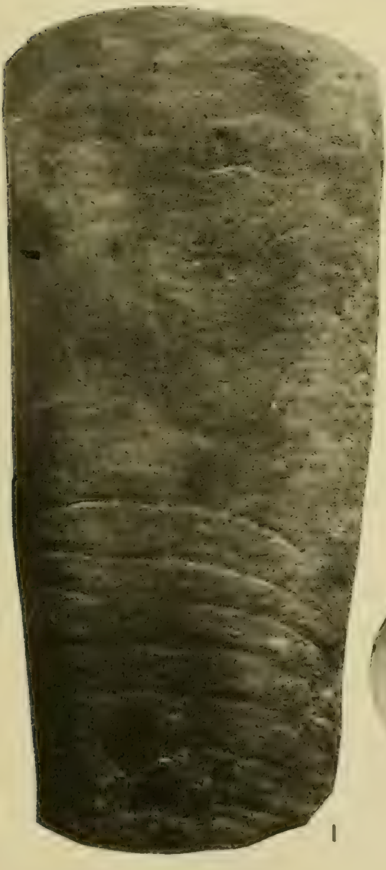
5

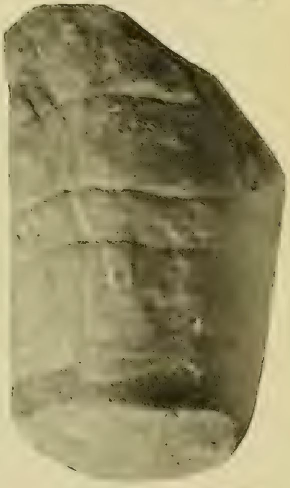
PLATE V

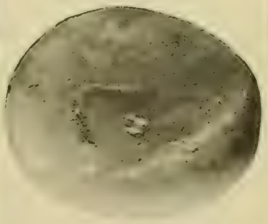
EXPLANATION OF PLATE 5

FIGURES		PAGE
1.	**Bradfordoceras transversum** Flower and Caster, sp. nov. Paratype. A compressed specimen. Pal. Res. Inst., No. 5020. *Lewis Run sandstone, Lewis Run, Pa.*	34
2.	**Bradfordoceras sinuosum** Flower and Caster, sp. nov. Holotype. Dorsal aspect. Pal. Res. Inst., No. 5024. *Lewis Run sandstone, Lewis Run, Pa.*	42
3.	**Bradfordoceras sinuosum** Flower and Caster, sp. nov. Septum of the same specimen showing the position of the siphuncle. Pal. Res. Inst., No. 5024.	42
4.	**Bradfordoceras sinuosum** Flower and Caster, sp. nov. Projection of the sutures of the holotype.	42
5.	**Bradfordoceras transversum** Flower and Caster, sp. nov. Paratype. A depressed young stage. Pal. Res. Inst., No. 5016. *Lewis Run sandstone, Lewis Run, Pa.*	34


4


1


2


3

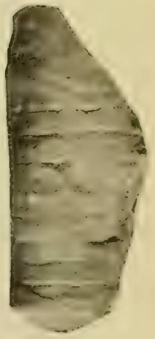

5

PLATE VI

EXPLANATION OF PLATE 6

FIGURES PAGE

1. **Bradfordoceras hector** variant **eta**, new variant 49
Holotype. Pal. Res. Inst., No. 5043.
Pope Hollow conglomerate, Tidioute, Pa.

2. **Bradfordoceras hector** variant **zeta**, new variant 48
Holotype. Randall Collection of the Warren High School. Warren, Pa.
Salamanca conglomerate, Warren, Pa.

3. **Bradfordoceras transversum** Flower and Caster, sp. nov. 34
Paratype. Acad. Nat. Sci. Phila., No. 9602.
Salamanca conglomerate, Warren, Pa.

4. **Bradfordoceras hector** variant **alpha**, new variant 45
Holotype. Yale Peabody Museum, No. 13740 A.
Salamanca conglomerate, Warren, Pa.

5. **Bradfordoceras hector** variant **beta**, new variant 46
Holotype. Yale Peabody Museum, No. 13740 B.
Salamanca conglomerate, Warren, Pa.

6. **Bradfordoceras hector** variant **beta**, new variant 46
Paratype. Yale Peabody Museum, No. 13740 D.
Salamanca conglomerate, Warren, Pa.

7. **Bradfordoceras sinuosum** Flower and Caster, sp. nov. 42
Paratype. Early stage. Lateral aspect. Yale Peabody Museum, No. 13740 E.
Salamanca conglomerate, Warren, Pa.

8. **Bradfordoceras hector** variant **beta**, new variant 46
Paratype. Early stage. Yale Peabody Museum, No. 13740 C.
Salamanca conglomerate, Warren, Pa.

9. **Orthoceras? sp.?** 55
The internal mold of a portion of the living chamber showing the surface markings and color bands. Slightly retouched. Pal. Res. Inst., No. 5053.
Pope Hollow conglomerate, (Salamanca), Tidioute, Pa.

10. **Blastoceras cylindrostomum** Flower and Caster, sp. nov. 51
Holotype. Ventral aspect. Pal. Res. Inst., No. 5052.
Lewis Run sandstone, Lewis Run, Pa.

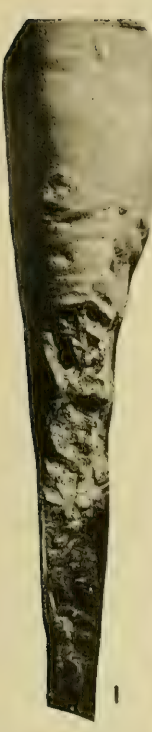
11. **Blastoceras cylindrostomum** Flower and Caster, sp. nov. 51
Same specimen, lateral aspect, the venter to the left.

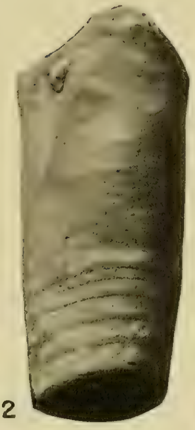
12. **Blastoceras cylindrostomum** Flower and Caster, sp. nov. 51
Same specimen, dorsal aspect, showing the mid-dorsal crest.

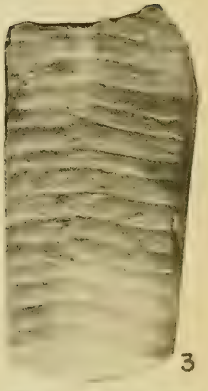
13. **Blastoceras cylindrostomum** Flower and Caster, sp. nov. 51
Adapertural aspect of the same specimen. Dorsal side down.

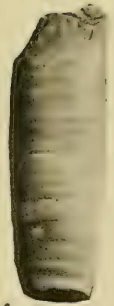
14. **Anglicornus anneliesae** Flower and Caster, sp. nov. 53
Holotype. Ventral aspect of a slightly weathered internal mold showing the siphuncle. Pal. Res. Inst., No. 5050.
Lewis Run sandstone, Lewis Run, Pa.

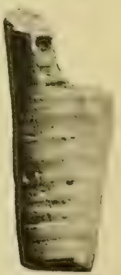
15. Anglicornus anneliesae Flower and Caster, sp. nov. 53
Right lateral aspect, showing the sinus which is due to distortion. Same specimen as fig. 14.

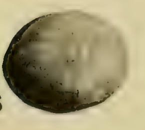

1

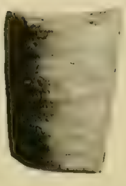

2

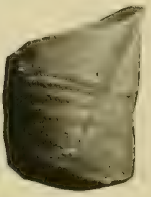

3

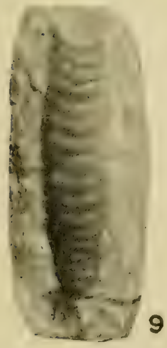

4

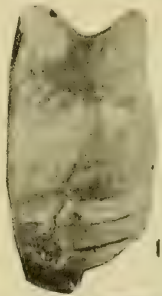

5

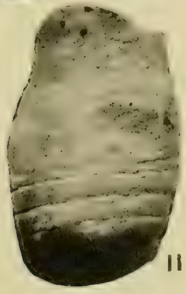

6

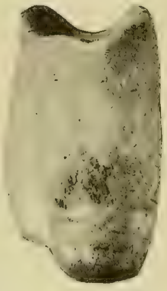

7

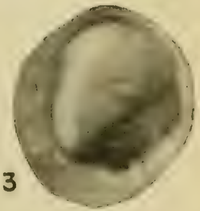

8

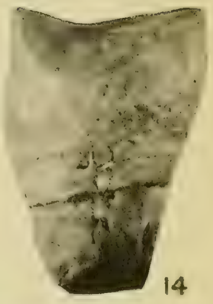

9


10


11


12


13


14

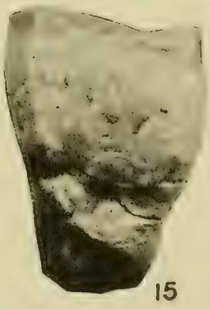

15

PLATE VII

EXPLANATION OF PLATE 7

FIGURES PAGE

1. **Pseudorthoceras palmerae** Flower and Caster, sp. nov. 31
Holotype, Ventral aspect. About seven-eighths natural size. Armstrong collection, Antioch College.
Coquinite of Panama age, Reynolds quarry, Erie Co., Pa.

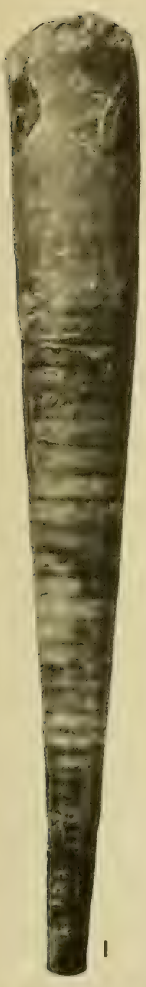
2. **Pseudorthoceras palmerae** Flower and Caster, sp. nov. 31
A section of a young portion of the same specimen.

3. **Pseudorthoceras palmerae** Flower and Caster, sp. nov. 31
The same section retouched to show the internal deposits of the camerae.

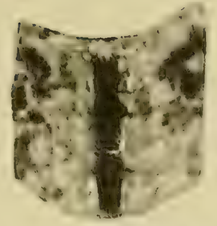
4. **Bradfordoceras consortale** (Hall) 39
Hypotype. A slightly compressed specimen. Randall Collection, Warren High School, No. 931.
Salamanca conglomerate, Warren, Pa.

5. **Bradfordoceras sinuosum** Flower and Caster, sp. nov. 42
Paratype. Early stage. Pal. Res. Inst., No. 5026.
Lewis Run sandstone, Lewis Run, Pa.

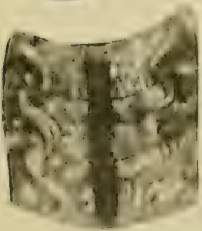
6. **Bradfordoceras multicameratum** Flower and Caster, sp. nov. 38
Holotype. Somewhat compressed. Randall Collection, Warren High School, No. 934.
Salamanca conglomerate, Warren, Pa.



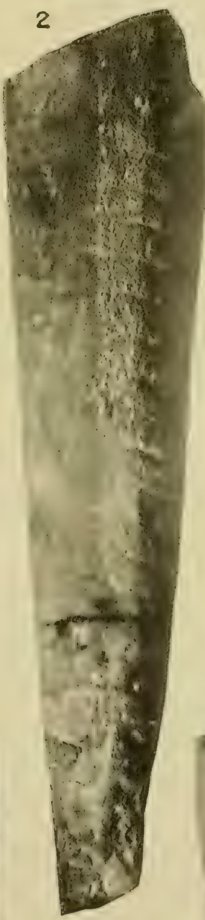
1



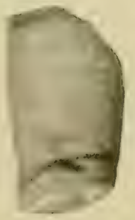
2



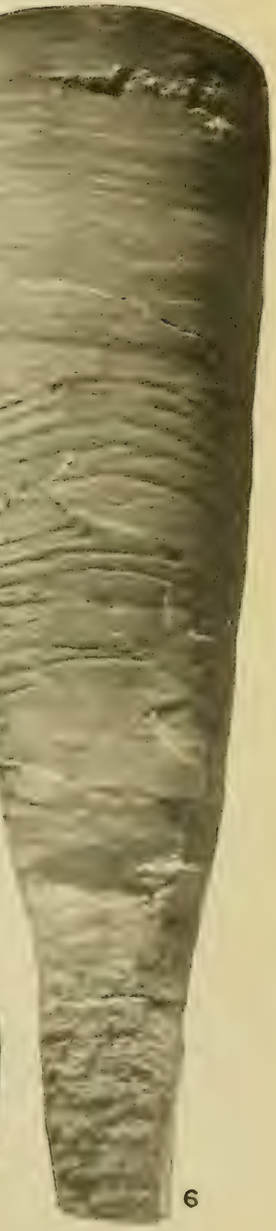
3



4



5



6

PLATE VIII

EXPLANATION OF PLATE 8

FIGURES PAGE

1. **Paralegoceras milleri** Flower and Caster, sp. nov. 55
Holotype. Armstrong Collection, Antioch College.
Lower Conewango (Panama?) Howard Quarry, Erie. Co., Pa.

2. **Paralegoceras milleri** Flower and Caster, sp. nov. 55
Projection of the suture of the same specimen, not including the dorsal internal suture.

3. **Bradfordoceras transversum** Flower and Caster, sp. nov. 34
Paratype. One side of a compressed specimen. Pal. Res. Inst., No. 5019.
Lewis Run sandstone, Lewis Run, Pa.

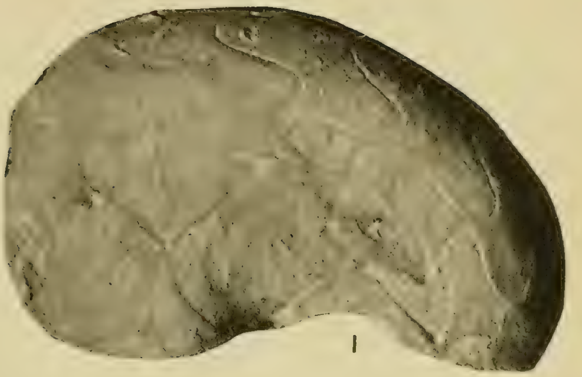
4. **Bradfordoceras transversum** Flower and Caster, sp. nov. 34
Opposite side of the same specimen.

5. **Bradfordoceras sinuosum** Flower and Caster, sp. nov. 42
Holotype, ventral aspect. Pal. Res. Inst., No. 5024.
Lewis Run sandstone, Lewis Run, Pa.

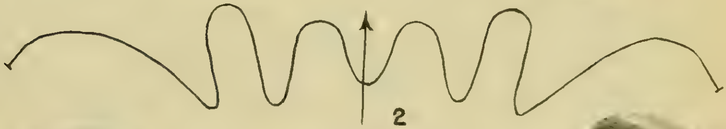
6. **Bradfordoceras hector** variant **delta,** new variant 47
Paratype. Portion of living chamber. Pal. Res. Inst., No. 5042.
Pope Hollow conglomerate, Tidioute, Pa.

7. **Bradfordoceras hector** variant **delta,** new variant 47
Holotype, Dorso-lateral aspect of an obliquely depressed specimen. Pal. Res. Inst., No. 5039.
Pope Hollow conglomerate, Tidioute, Pa.

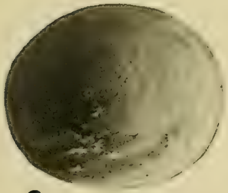
8. **Bradfordoceras hector** variant **delta** new variant 47
Holotype, adapical aspect showing the section and the position of the siphuncle.



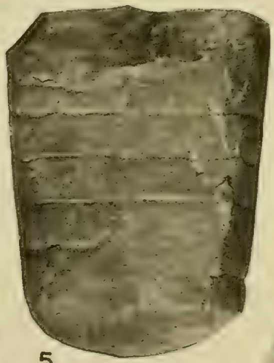
1



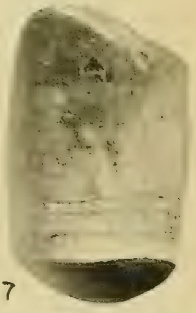
2



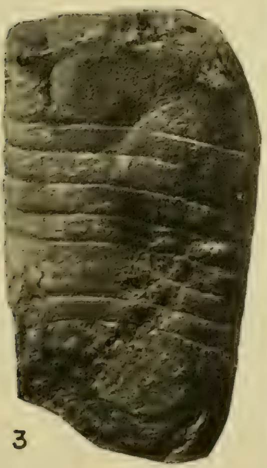
8



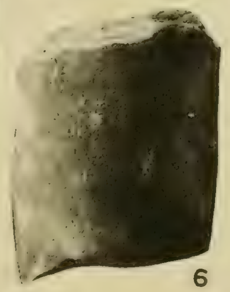
5



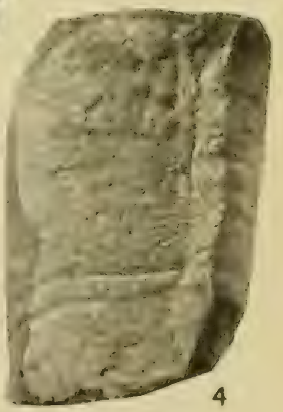
7



3



6



4

BULLETINS

OF

AMERICAN PALEONTOLOGY

Vol. 22

* * *

No. 76

Cherry Valley Cephalopods

By Rousseau H. Flower

PALÆONTOLOGICAL RESEARCH INSTITUTION
FOUNDED 1932

August 4, 1936

Ithaca, New York

CHERRY VALLEY CEPHALOPODS

by

Rousseau H. Flower

INTRODUCTION

This is the second[1] of a series of contemplated papers dealing with Devonian nautiloids. Here attention is confined to the fauna of a thin limestone band of the Middle Devonian, the Cherry Valley limestone. This was chosen partly because of availability, partly because of the excellent state of preservation of the fossils, and partly because it was hoped that the abundance of well preserved forms might yield more information than is usually contained in the description of genera and species. The study began with the assembling of a collection. It was continued by an examination of the available types, and the results were such that a revision of the fauna seemed desirable. The study was made possible through the cooperation of a number of individuals and institutions. I wish to express my indebtedness first of all to Dr. K. E. Caster for encouragement and much good advice and criticism, and also for assistance in collecting. The examination of the type specimens in the New York State Museum at Albany, New York, was possible through the kindness of Dr. Rudolph Reudemann. The Museum has furnished numerous photographs of types and also of previously unfigured specimens through the courtesy of Dr. C. G. Adams, Director of the Museum. I am further indebted to Miss Winifred Goldring of the New York State Museum who kindly sent me a specimen of *Striacoceras typum* from the Berne member of the Marcellus. I also wish to express my indebtedness to Dr. Burnett Smith of

---

[1] For the first, see Flower, R. H. and Caster, K. E. The stratigraphy and paleontology of Northwestern Pennsylvania. Part II: Paleontology. Section A: The cephalopod fauna of the Conewango series of the upper Devonian in New York and Pennsylvania. Bull. American Paleontology., vol. 22, no. 75. 1935.

Skaneateles, New York, for a collection of Cherry Valley cephalopods made near Marcellus[2]. Thanks are also due to Dr. Chester A. Reeds of the American Museum of Natural History who furnished me with careful measurements and notes on the types of *Acleistoceras fischeri* and *Verticoceras conradi.*

Among those who have aided in field work Dr. Caster has already been mentioned. Mr. Eric Swarthe and Mr. Herrick Smith lent valuable assistance in collecting at Union Springs. I wish also to express my indebtedness to my father, Mr. Franklin R. Flower, with whom I have spent many pleasant hours in the field. The expense of the field work has been met by my aunt, Miss Lilian E. Flower.

Mrs. K. E. Caster furnished the drawing of a restoration of *Tetranodoceras transversum.*

Perhaps the greatest debt is that to Professor G. D. Harris and the Paleontological Research Institution, for offering facilities necessary for the completion of this study, the use of photographic equipment, and for bearing the greater part of the expense of the plates. The collection which formed the nucleus of this study will be deposited in the Paleontological Research Institution in its entirety, for much of its value depends upon the large series of specimens of *Striacoceras typum* illustrating geographical and other variations.

The material.—Inasmuch as some conclusions are drawn from the abundance, presence or absence of the speceies at various localities, some mention should be made of the basis for these statements. At the New York State Museum I have had access to the extensive collections made at Manlius, which is the type locality for most of the Cherry Valley cephalopod species, also the collection made at Schoharie by the John Gebhards, father and son, and purchased by the Museum.

My own material consisted of extensive collections made at Union Springs and Stockbridge, and a small collection made at Cherry Valley. This material was supplemented by a small but significant collection from Marcellus village contributed by Dr.

---

[2] All of the localities of the Cherry Valley limestone mentioned in this paper are in New York State.

Burnett Smith, and a few specimens from various localities in the Cornell University Collection. For data on the fossils west of Cayuga Lake I have had to depend upon the accounts and lists of Dr. J. M. Clarke, and for the data on the fauna of the Helderberg region I am indebted to Miss Goldring.

The Ammonoidea are given little space in this paper. Though abundant in numbers, they are few in species in the Cherry Valley limestone, and these are being included by Dr. A. K. Miller in a monograph which will cover the known Devonian forms, and which is at present in press. It has seemed best to limit the discussion of that group to the data in the faunal lists and to the description and notice of new material.

Rousseau H. Flower

Paleontological Research Institution
March 16, 1936.

THE LIMESTONE

The Cherry Valley limestone[3] is the "Goniatite" limestone of the older authors under a geographic name. It occurs typically above the black shales of the Union Springs member of the Marcellus[4] and is typically developed only in New York State.

The limestone varies somewhat in thickness but never exceeds three feet. Weathered outcrops show a definite division of the formation into two subequal parts. The characteristic fauna is found in the lower half of the upper layer. At Union Springs well preserved specimens are confined to a single level in this part of the limestone, with the layers above and below containing only broken fragments. At Stockbridge there are well preserved fossils in two such layers. Whenever it was possible to work a piece of limestone in place so that the top could be determined, it was found that the uppermost parts of the fossils were almost invariably destroyed, indicating that the animals were partly buried in the mud either at the time of their death or very soon after, but that the sediments did not accumulate with sufficient rapidity to preserve them entirely.

---

[3] Clarke, J. M. New York State Museum, Handbook no. 19, p. 20. 1903.

[4] Cooper, G. A. Stratigraphy of the Hamilton (N. Y.) Group, pt. 1, Amer. Jour. Sci., ser. 5, vol. 19, p. 130-131. 1930.

In its east-west distribution certain changes take place in the limestone. Everywhere it is rich in carbonaceous material, but the character of the limestone varies. The formation is absent as a lithological unit in the Helderbereg section, but Miss Goldring[5] has recently reported a fauna from that area which indicates that the horizon is present and that a few of the characteristic species penetrated this region.

At Schcharie the limestone is found 70 feet above the Onondaga according to Dr. Cooper[6]. Clarke's[7] statement that the distance is 30 feet must be a misprint, but Grabau[8] failed to detect the error.

The limestone is shaly here, and carries a typical Cherry Valley nautiloid fauna, with the accompanying brachiopods, pelecypods and pteropods, but the large *Agoniatites vanuxemi* has not as yet been reported from this area in spite of extensive collecting. The section at Cherry Valley shows the appearance of a limestone thirty or forty feet above the top of the Onondaga. About sixty feet above this, limestone appears again in the section. Clarke[9] considered the upper limestone the Cherry Valley. According to Cooper[4], there is only one limestone here, which is folded into a low arch, and in its second appearance in the section the crest of the arch is exposed. The limestone here is divided into two layers by about a foot[10] of grey shales, which contains *Agoniatites nodiferis* (Hall). The upper limestone is said to contain the characteristic Cherry Valley fauna. We have found it relatively barren. Below the lower layer *Anarcestes plebiformis* occurs.

At Stockbridge Falls, Madison County, the Cherry Valley limestone is well developed and carries a very rich fauna. It is

[5] Goldring, Winifred Geology of the Berne Quadrangle. New York State Museum Bull., no. 303, p. 156-58, fig. 57. 1935.

[6] Cooper, G. A. Stratigraphy of the Hamilton Group of Eastern New York. Amer. Jour. Sci., ser. 5, vol. 26, p. 547. 1933.

[7] Clarke, J. M. Limestones of central and western New York interbedded with bituminous shales of the Marcellus stage with notes on the nature and origin of their faunas. New York State Museum Bull., no. 49, p. 123. 1901.

[8] Grabau, A. W. Geology and Paleontology of the Schoharie Valley. New York State Museum Bull., no. 92, p. 208. 1906.

[9] Clarke. Ibid., p. 123.

[10] Not four feet as stated by Clarke.

not over twenty five feet above the top of the Onondaga, and the Union Springs member contains thin calcareous bands. At Union Springs the thickness of the Union Springs member has decreased to less than twenty feet, and the calcareous bands are more prominent. Outcrops are rare west of Cayuga Lake, but it appears that the westward thinning of the Union Springs member continues, for in Erie County Clarke[11] obtained a large *Agoniatites* from a limestone layer at the top of the Onondaga.

The conditions under which the limestone was laid down do not seem to have been mentioned either by Clarke or Cooper. We venture to suggest that conditions were as follows:

At the close of the Ulsterian epoch there was a rise of the continent of Appalachia, which lay to the east of the Devonian sediments of New York. It is quite possible that this rise might be connected with the disturbance of the upper Onondaga as shown at Clarkesville, Albany County[12], though that deformation is usually attributed to a much later period. Previous to the elevation, the continent had been a low lying one, and had not furnished any significant contribution to Devonian sediments except possibly indirectly in the Oriskany-Schoharie interval. This will not seem peculiar if it is remembered that in the long interval in which the sea did not cover eastern New York, from the late Ordovician to the late Silurian, erosion was taking place, and there was ample time for peneplanation to be completed so that when the seas returned there was practically no material of continental origin carried into them. On such a continent it is not unlikely that conditions were in a large part palustrine, which would result in highly carbonaceous muds largely derived from plant remains. When the continent was elevated, this mud was the first of the soils to be washed out into the sea, not all at once, but a little at a time, as is shown by the fine bedded structure of the Marcellus.

The deposition of the palustrine muds was concentrated in the shoreward or eastern portion of the state, while little material reached the western part where limestone deposition continued unbroken up to Cherry Valley time[13].

---

[11] Clarke. Ibid., p. 121.

[12] See Ruedemann, R. Geology of the Capital District. New York State Museum Bull. no. 285, fig. 75. 1930.

Into this environment there finally penetrated a fauna of large cephalopods, the shells of which are the most characteristic feature of the Cherry Valley limestone. They found already established there a fauna of thin shelled pelagic organisms such as seem to characterize most black shale environments, and which must have made up a considerable portion of their food. It is of course open to question whether the shells which made up the limestone were the cephalopods or whether its formation was due in a large part to other organisms, possibly the pteropods. In the light of the character of the preservation of the cephalopods in the one layer in which they are abundant, it appears probable that their apparent absence in the lower layers is due to the slow rate with which the sediments accumulated, which was not adequate for the rapid burial of the shells so essential for their preservation, and as a result of this many of the conchs were destroyed, the calcareous material of the shells finally solidifying into the limestone. Only at one brief interval was the accumulation of sediments adequate for burial and preservation of the cephalopods, and even here burial was not sufficient to insure the preservation of the portions of the larger individuals which lay uppermost. Further, the only known alternative organisms which could have played a large part in the limestone building are the pteropods, but the Cherry Valley shows none of the features of a pteropod limestone, and in fact, representatives of this group are much more abundant in the shales of the Union Springs member.

It would appear, then, that the cephalopods held sway for a considerable period of time, though a relatively short one geologically, and in that time the accumulation of sediments was too slow to effect good preservation except at one rather brief interval.

---

[13] Dr. Chadwick, on the basis of an erosional surface at the top of the Onondaga at Catskill, New York, believes that the break between the Onondaga and the Hamilton is of fundamental importance. This is certainly not applicable to the east-west exposures across central New York, where the contact is gradational. It would appear that the post-Onondaga emergence was local and was probably connected with the rise of Appalachia.

A word might be added concerning the origin of the fauna. It appears that the cephalopods must have come in from the south. The embayment was bordered on the north and the east by the Adirondacks and the continent of Appalachia. The marked paucity of cephalopods in the western part of the state would seem to indicate that the fauna did not come by that route. Inasmuch as the fauna as shown below is divisible into two partially overlapping elements each of which has its own boundaries in regard to east-west distribution which were doubtless connected with the ecological factors of depth, temperature, amount of sediment and possibly also light, it is much more logical to believe that the two faunas made their way northward into the embayment in such a way that, by thus skirting the continent in their respective zones, the organisms could migrate without encountering adverse conditions.

Known occurrence of cephalopods in the Cherry Valley limestone, showing the east-west distribution.

	1.	2.	3.	4.	5.	6.	7.	8.	9.
Michelinoceras swarthi Flower	-	-	b	-	-	b	-	-	-
Diagoceras aptum (Hall)	-	-	b	b	b	b	-	e	-
Striacoceras typum Saemann	-	c	a-b	a	a	a	a	a	b
Striacoceras kionoceroides Flower	-	-	-	-	-	b	-	-	-
Spyroceras geneva Clarke	-	-	-	-	-	-	b	-	-
Spyroceras cf. nuntium (Hall)	-	-	-	-	-	b*	-	-	-
Casteroceras alternatum (Hall)	-	-	-	-	b	b	b	b	-
Tetranodoceras transversum (Hall)	-	-	b	-	b	b	-	b	-
Nephriticeras bucinum (Hall)	-	-	-	-	b	-	-	-	-
Lyricoceras liratum (Hall)	-	-	-	-	b	-	-	-	-
Lyricoceras dubium Miller	-	-	-	-	b	-	-	-	-
Centroceras marcellense (Vanurem)	-	-	b	-	b	b	-	b	b
Palmeroceras fustis (Hall)	-	-	-	-	b	-	-	e	-
Acleistoceras fischeri (Hall)	-	-	-	-	b	-	-	-	-
Ovoceras									

oviforme (Hall)	-	-	-	-	-	-	-	b	-
Ovoceras constrictum Flower	-	-	-	-	b	b	-	b	-
Ovoceras (?) gibbosum (Hall)	-	-	-	-	-	b	-	b	-
Poteriocerina solidum (Hall)	-	-	-	-	b	?	-	-	-
Verticoceras erectum Flower	-	-	-	-	-	-	-	b	-
Verticoceras sp. Flower	-	-	-	-	-	-	-	b	-
Verticoceras conradi (Hall)	-	-	-	-	b	-	-	-	-
Bactrites clavus Hall	-	-	-	-	-	b	b	b	b
Agoniatites expansus (Hall)	c	c	a	a	a	a	a	-	-
Agoniatites intermedius Flower	-	-	b	-	-	-	-	-	-
Agoniatites floweri Miller	-	-	-	-	-	b	-	-	-
Parodiceras discoideum (Hall)	-	-	b	b	b	b	-	b	d

*Cazenovia
1. Erie County
2. Canandaigua lake
3. Union Springs
4. Marcellus
5. Manlius
6. Stockbridge
7. Cherry Valley
8. Schoharie
9. Helderberg section

a. abundant
b. present
c. Reported by J. M. Clarke
d. Reported by Miss Goldring
e. Reported by A. W. Grabau

c, d and e are used only when the author has not seen a specimen from the locality in question.

DISTRIBUTION AND ECOLOGY OF THE CEPHALOPODS

The distinct lithological and faunal unit which goes to make up the Cherry Valley limestone offers opportunity for a study which is rarely granted the paleozoologist: a study of variation in a series of specimens so restricted vertically that they can be regarded as contemporaneous, and distributed throughout an area large enough to exhibit some regional modification of the fauna. The accompanying chart shows the known occurrence of the cephalopods at the various outcrops, and though the data for many of the localities would doubtless be increased by further collecting, we are in a position to draw some conclusions concerning the east-west distribution of the fauna and its significance. The genus *Agoniatites* is represented by four species in the Cherry Valley limestone, one of which, *A. nodiferis* (Hall) is confined to a shale seam separating the upper and lower blocks of the limestone at Cherry Valley, and is known only from that locality. *A. floweri* Miller is known from two specimens from Stockbridge and one from Manlius. *A. intermedius* is known from a single specimen from Union Springs. *A. expansus*, on the other hand, is the most characteristic and abundant fossil in the limestone. It makes its most easterly appearance in the limestone some distance west of Schoharie according to Grabau[14], and from there it increases in abundance westward to Stockbridge and Manlius. It is still abundant west of Lake Cayuga, where the nautiloids disappear, and was reported from Genesee and Erie counties by Clarke[15]. As far as is indicated by abundance, variability and size, the optimum conditions for *Agoniatites* seem to center about the region from Stockbridge to Union Springs.

The nautiloids as a group have a slightly different distribution. They are typically developed from Schoharie to Manlius, but they appear to be poorly represented at Union Springs, and farther west only sporadic orthoceracones are found. On the other hand, they seemed to live without difficulty in the Schoharie region where the deposition of the black mud was sufficiently rapid in Cherry Valley time that the limestone is definitely shaly. A few forms, notably *Striacoceras typum and Centroceras marcellense* occur in the Helderberg area in the Berne quadrangle[16].

---

[14] Grabau, A. W. Geology of the Schoharie Valley. New York State Museum Bull., no. 92, p. 208-9. 1906.

[15] Clarke, J. M. Ibid., p. 120, 121, 125.

Of the nautiloids, *Striacoceras typum* is the most abundant and it is this species which has furnished the most significant biological data. It is a highly variable species, and one which exhibits such marked differences in rate of expansion, position of gerontic constriction, maximum size and depth of cameræ that only by the study of a large series of specimens could the specific identity of these forms be established. In one instance a *Striacoceras* was found which exhibited such a marked difference from the others in the one character which did not seem to vary elsewhere, the ornamentation, that we have erected a new species for its reception. Elsewhere it was evident that we had to do with a single but highly plastic species. In the taxonomic portion of this paper we have described in detail the variations which occur in *S. typum,* and it will suffice here to review their significance. Forms with relatively deep cameræ a very gradual rate of expansion and with the gerontic constriction located at a relatively late period, that is, forms which exhibit all of the signs of an organism which developed at a rapid rate of growth under optimum conditions, were found commonly at Manlius, Stockbridge, Cherry Valley and Schoharie, but were not represented at Union Springs in spite of the large number of specimens from that locality available for study. The prevalent form at that locality was one in which there was a marked tendency toward a reduction in the size of the mature conch as indicated by the gerontic contraction, an irregularly increased rate of expansion, and relatively shallow cameræ. Everything in short, pointed toward a slowing up in the rate of secretion of the shell by the terminal mantle, which indicates existence under conditions less favorable than those which obtained a little farther east. At Union Springs the orthoceracones are less abundant, both in actual numbers and in proportion to the *Agoniatites*, than at Manlius or Stockbridge, and shortly west of Lake Cayuga they disappear entirely from the limestone. Their extent to the east is proportionately greater, and further the presence of several variants, (alpha, beta and gamma) at Schoharie in the shaly limestone indicates that the orthoceracones could thrive in an environment which was receiving considerable clastic material. Further, stray specimens have been found in the Helderberg area where there is no limestone. The orthoceracones of the Cherry Valley limestone were benthonic forms, as is indicated by the presence of deposits within the camerae of even immature specimens. They represent a faunal group which required shallow water and which could thrive well near shore, though they failed to penetrate west where the water was deeper. The other nautiloids appear to have the same distribution so far as is known, though inasmuch as a number of the species are known only from one locality, generalization is not safe. *Agoniatites* however, appears to have thriven best under conditions of slightly deeper water, and failed to penetrate a near shore environment. The same relation is found in the lower part of the Upper Devonian, where the orthoceracones characterize the sandy Ithaca facies while the ammonoids characterize the more westerly beds which were laid down in deeper and presumably cooler water, farther from the shore.

---

[16] I am indebted to Miss Winifred Goldring of the New York State Museum who loaned a specimen of an orthoceracone from the Berne member of the Marcellus at Camp Pinnacle of the Berne quadrangle, which we were able to identify beyond reasonable doubt as conspecific with the Cherry Valley **Striacoceras typum.** It was also Miss Goldring who reported the occurrence of **Centroceras marcellense.** See footnote 3.

Most of the nautiloid species are relatively rare, and their absence in many localities cannot be stressed too strongly. This is particularly true in relation to the outcrops at Cherry Valley which are not accessible, though we were able to collect from loose pieces in stream beds. On the contrary, a very extensive collection was made from Union Springs and while it is not impossible that certain forms range into that section which have not as yet been found there, it appears that the brevicones are in reality absent. These forms range from Manlius to Schoharie, but are nowhere abundant.

Three of the forms, *Casteroceras alternatum, Tetranodoceras transversum* and *Centroceras marcellense,* are characterized by the presence of nodes or blunt spines on the shell. That this is an ecological phenomenon is shown by the presence of similar nodes and spines on *Agoniatites floweri, A. nodiferis,* and *A. intermedius,* which belong to a genus whose other species are without any such ornamentation.

The spinosity of the Cherry Valley cyrtoceracones, gyroceracones and nautilicones was first pointed out by Hall who contrasted this type of ornamentation with the continuous transverse frills which characterize the cyrtoceracones and gyroceracones of the Onondaga. The significance of this phenomenon has never been explained.

RELATIONSHIP

Most of the Cephalopods of the Cherry Valley limestone are confined in range to that formation. There are, however, a few which have a greater vertical range. Of these the most long-lived is *Parodiceras discoideum,* which appears in the Union Springs member and ranges well up into the Hamilton shales. *Bactrices clavus* is reputed to come from the "Marcellus shales at Schoharie, N. Y"[17]. The type is from the Cherry Valley limestone. *Spyroceras geneva,* if the horizon of the holotype was determined correctly, is a species which ranges from the Onondaga into the Cherry Valley member, and probably higher. Some of the specimens which Hall figured under *Spyroceras crotalum* of the Hamilton may be conspecific.

A few of the forms in the Cherry Valley seem to range upward into the Ludlowville and possibly into the Moscow. *Lyrioceras liratum* and *Nephriticeras bucinum* appear to have such a range. *Striacoceras typum,* under the old name of *Protokionoceras marcellense,* has been reported from various parts of the Hamilton from time to time[18] [19]

---

[17] Hall, J. Paleontology of New York, vol. 5, pt. 2, p. 317. 1879.

[18] Clarke, J. M. Limestones of central and western New York interbedded with bituminous shales of the Marcellus stage with notes on the nature and origin of their faunas. New York State Museum Bull., no. 49, p. 131, 133; 1901.

[19] Wood, Elvira. Marcellus (Stafford) limestones of Lancaster, Erie Co., N. Y., ibid., p. 147, 152, 153.

It has not been possible to examine the specimens upon which these determinations were based, but it is not impossible that this species may range upward into the Stafford. *Agoniatites vanuxemi* (Hall) has also been reported from above the Cherry Valley member[20].

Concerning the distribution of the genera little need be said here, as the subject is treated under the generic discussions. The relations of *Michelinoceras* and *Spyroceras* show little that is significant, for both genera are very long-lived and show little variation. *Striacoceras* may be regarded as a Devonian development out of the non-annulated Kionoceratidae of the Silurian. Some quite typical *Kionoceras* also appears in the Hamilton. *Tetranodoceras* is a member of the Rhyticeratidae, a group which is typically developed in the Onondaga. *Casteroceras* also might be placed in that family, but shows relationships with species from Canada and is not closely related to any of the New York Onondaga species. The Nephriticeratidae characterize the Hamilton very much as the Rhyticeratidae characterize the Onondaga. The family shows a superficial resemblance to *Cyrtoceras* Goldfuss of the Middle Devonian of Europe, but lacks the apertural contraction and the lamellae of the siphuncle. Little can be said concerning the brevicones except that they are typical Devonian forms.

Acleistoceras fischeri is a more typical representative of the genus than are some of the species recently referred to it by Dr. Foerste from the Alpena limestone[21]. This appears to be a good genus which characterizes the middle Devonian of America. *Verticoceras* may be allied to *Alpenoceras* Foerste[22] but we have not been able to regard their species as congeneric.

[20] Clarke, J. M. **Ibid.**, p. 143.

[21] Foerste, A. F. Devonian Cephalopods from Alpena, Michigan. Michigan Univ. Mus. of Geology, Contrib., vol. 2, p. 190-204. 1927.

[22] Foerste, A. F. **Ibid.**, p. 205-8.

CEPHALOPOD MORPHOLOGY

Adequate discussions of the morphology and current terminology of the commonly known parts of the nautiloid shell have been published recently by Troedsson[23], Foerste and Teichert[24], and by Miller, Dunbar and Condra[25].

It is intended that the matter will be dealt with further at another time, but it seems advisable to point out here several structures which need some introduction and which are pertinent to the cephalopods described below.

The longitudinal carinæ.—These carinæ show upon the internal molds of certain orthoceracones and appear to be structures of the middle or inner layers of the shell. Their function is unknown. Transverse sections have so far failed to show these structures. There are normally three such carinæ on the ventral side in the genus *Striacoceras.* No satisfactory theory has been advanced for their function. On the dorsal side of a few specimens there seems to be a somewhat different sort of carina. This is strong at the adapertural end of each air chamber, but weak adapically. A very similar structure occurs on the ventral side of "*Loxoceras*" *luxum* (Hall)[26]. Hall suggests that this carina represents a connection between the cameræ and the soft parts of the animal. In view of the very regular pattern formed by the edges of the deposits, it appears that some living functional mantle must have been present within the cameræ. If some such direct connection could be established, it would do much to remove the difficulty involved in explaining how the membrane and the rest of the organism could be connected. The only other possible connection is through the connecting ring of the siphuncle, and thus far that part has yielded no trace of even minute pores.

---

[23] Troedsson, G. On the upper and middle Ordovician faunas of northern Greenland. pt. 1, Cephalopoda. Jubilaeumsekspedition Nord om Gronland, 1920-23; no. 1, p. 12-24. 1926. Republished in Meddelelser om Gronland, bd. 71, same page reference, 1929.

[24] Foerste, A. F., and C. Teichert. Actinoceroids of east-central North America, Denison Univ., Bull. Jour. Sci. Lab., vol. 25, p. 220-23. 1930.

[25] Miller, Dunbar and Condra. The nautiloid cephalopods of the Pennsylvania system in the mid-continent region. Nebraska Geol. Surv., Bull., no. 9, p. 20-38. 1933.

[26] See Hall, J. Paleontology of New York, vol. 5, pt. 2, p. 246, pl. 35, fig. 5-6. 1879.

Deposits within the cameræ.—These have been studied recently by Teichert[27] in the actinoceroids. He mentions three types of deposits:

1. Episeptal—formed on the concave side of the adapical septum and against the outer wall.

2. Hyposeptal deposits—Formed on the convex side of the adapertural septum, not attaining the septal neck, but reaching the outer corner, the point at which the convex side of the septum joins the wall of the conch. At this point when hyposeptal and episeptal deposits are well developed they meet along a line which has been called the *pseudoseptum.*

3. The "Stutzring."—In the absence of any simple English equivalent the term *collar* is proposed as being both short and descriptive. These deposits are formed outside the septal necks of actinoceroids.

In addition we propose the application of the term *circumferential deposits* to those deposits which resemble the episeptal deposits in the early stage, but which develop in such a way that in the later stages of the deposition the deposit appears to be truncated anteriorly by the adoral septum.

CEPHALOPOD CLASSIFICATION

In this paper it has been considered best to follow the classification of Hyatt insofar as was possible. That this system has its faults has long been obvious; particularly difficult are the boundaries between the Orthochoanites and the Cyrtochoanites. Within the past three years several attempts have been made to replace this system by a more rational one, but these attempts have resulted in such radical changes in the terminology of the major groups, and so much conflict with one another, that it seems best not to adopt any of the recent classifications until it has been further substantiated[28].

---

[27] Teichert, Curt. Der Bau der Actinoceroiden Cephalopoden. Paleontopographica, bd. 78, abt. A, p. 168-186, Text fig. 25-42. 1933.

[28] A survey of these classifications and an even newer one can be found in Schindewolf, O. H. Bemerkung zur Ontogenie der Actinoceren und Endoceren. Sonder-Abdruck aus dem Neuen Jahrbuch fur Mineralogie etc. Bei. Bande 74, Abt. B., s. 89-113. 1935.

ORTHOCERATIDAE Hyatt, 1900

It appears that this family should include those cephalopods which are essentially straight, though the young may be slightly cyrtoconic, in which the siphuncle is variable in position, but is orthochoanitic in structure and normally empty. The shell is typically smooth, but may bear transverse markings ranging from fine lines of growth to the more specialized ornamentation of *Geisonoceras.*

This is a group of rather generalized forms which are long-ranging. It appears that the following genera should be placed here: *Orthoceras, Michelinoceras, Geisonoceras, Geisonocerina, Diagoceras* and *Ephippiorthoceras.* Possibly *Protobactrites* will be placed here when the genotype is better known, and *Bactrites* might be regarded as a Devonian end development of a part of the stock.

MICHELINOCERAS Foerste

Genotype: **Orthoceras michelini** Barrande

Foerste, A. F., 1932, Denison Univ. Bull. Jour. Sci. Lab., vol. 27, p. 72.

Since it has been pointed out that the genus *Orthoceras* is to be confined to those species in which the internal mold of the living chamber bears three longitudinal fossæ, the genus *Michelinoceras* was erected for the reception of those forms which were formerly understood to be *Orthoceras* in the strict sense; forms in which the section was circular, in which the rate of expansion was very slight, and in which the cameræ were deep and the siphuncle central, empty, and orthochoanitic. If *Michelinoceras* is to be confined to such forms, there are a great many species in which the cameræ are shallow, in which the section is circular, and the siphuncle tubular and either slightly eccentric or central, which are without a home. Inasmuch as it seems unlikely that any good line can be drawn to separate the forms which constitute the typical *Michelinoceras* and these other forms, it seems best to employ the name in a broader sense, in fact in almost as broad a sense as that in which *Orthoceras* has been used in the last ten years.

Michelinoceras swarthi Flower, sp. nov. Plate 1, fig. 1-3.

This species is known from several mature living chambers one of which bears two adapertural cameræ, and one fragment from near the apex of the conch.

Conch orthoconic, circular in section. All specimens agree in possessing a gradual and even rate of expansion of 2 mm. in a length of 20 mm. This continues unbroken to a point where the internal mold is constricted by the gerontic internal thickening of the shell. This occurs at various stages, some specimens being considerably larger than others. The sutures are straight and transverse. The siphuncle is poorly preserved, but appears to be small and central or subcentral in position. Its structure is not known, but it is assumed to be orthochoanitic. The septum is moderately convex; being 4 mm. in depth where the diameter is 11 mm. The cameræ appear to be about 5 in a length equal to the adapertural diameter of 15 mm.

In the holotype the living chamber is about two and a half times the diameter at the base, which is 15 mm. The diameter increases to 18.2 mm. in a length of 26 mm., beyond which in 3 mm., the shell contracts to 17.4 mm. The interior expands to 18 mm., 6 mm. beyond the beginning of the contraction. The aperture appears to be transverse and is 41 mm. beyond the base of the living chamber.

In the smaller specimens the contraction is proportionately narrower and nearer the base of the living chamber. Where the living chamber is 11 mm. in diameter at the base, the constriction begins 22 mm. beyond, the greatest diameter there being 13 mm. The aperture of this specimen is not preserved.

The ornamentation of this specimen consists of fine transverse striæ and lines of growth. In the adapical portion the striæ are inconspicuous and appear to be rather irregular. In the mature portion the striæ are fine, rounded and distant, occurring at regular intervals of almost exactly 1 mm.

Discussion.—There has been no previous record of a small orthoceracone in the Cherry Valley limestone. This species is known from a small series of mature living chambers and one portion of the adapical part of the phragmocone. The rate of expansion and the depth of the cameræ will not serve completely to distinguish this form from some of the smaller species of *"Orthoceras"* described from the Hamilton shales, for many of these are known only from more or less crushed fragments. The ornamentation, however, is different from that known in any of the Hamilton species. This species is named in honor of my very good friend Mr. Eric Swarthe, who aided in collecting.

Types.—Holotype: Pal. Res. Inst. no. 5332. Paratypes: Pal. Res. Inst. no. 5333-5335.

Occurrence.—In the Cherry Valley limestone at Union Springs and Stockbridge. The species is probably widespread, and does not appear to be uncommon, but has probably been overlooked in the past as a young specimen of *Striacoceras typum.*

Michelinoceras uniconstrictum (Miller)

Orthoceras constrictum Vanuxem, L., 1842, Geology of New York, vol. 3, Report of the Third District, p. 152, fig. 1.

Orthoceras constrictum Hall, J., 1861. Descriptions of new species of fossils. 14th Rep. New York State Cab. Nat. Hist., Appendix B, pl. 14, fig. 10.

Orthoceras constrictum Hall, J., 1862, Contributions to Paleontology. 15th Rep. New York State Cab. Nat. Hist., p. 77.

Orthoceras uniconstrictum Miller, A. K., 1933, Amer. Jour. Sci., vol. 24, p. 331.

Not

Orthoceras constrictum Conrad, T. A., 1838, Geol. Surv. New York, Paleontology Department, Annual Rep., p. 111, 117.

Not

Orthoceras constrictum Hall, J., 1879, Paleontology of New York, vol. 5, pt. 2, p. 288-89, pl. 84, fig. 13-16; pl. 85, fig. 5 10, 11, 13.

Not

Orthoceras constrictum Grabau, A. W., and Shimer, H. W., 1910 North American Index Fossils, vol. 2, p. 51-52, fig. 1251.

The name *Orthoceras uniconstrictum* Miller was proposed to replace *Orthoceras constrictum* Vanuxem 1842, which was preoccupied by *O. constrictum* Conrad 1838. The name seems an ill fated one. Conrad described under that name an annulated orthoceracone from the Hamilton. The specimen is lost, the figure and description are so inadequate that no more specimens can be referred to this species. The description is as follows:

> *Orthoceras constrictum.*—Shell smooth, tapering gradually, with a few remote transverse furrows[29]. Locality, town of Madison, Madison County.

Conrad's mention of the locality offers a possible solution for this problem by means of a neotype selected from topotype material. While this process would be legitimate, its value is very doubtful, for the form is probably conspecific with one of the annulated orthoceracones of the Hamilton adequately described and figured by Hall.

---

[29] Probably spaces between the annuli.

Vanuxem's *Orthoceras constrictum* was described from the internal mold of a living chamber of a smooth orthoceracone, which bore just before the aperture a marked rather narrow constriction. The description was accompanied by a good figure. Vanuxem did not state from what locality this specimen came, and the present location of his specimen is unknown. Indeed there appears to be good reason for believing that the specimens which Vanuxem used in his description of fossils in the Report of the Third District are actually lost. From internal evidence it is clear that they were not at Hall's disposal when he wrote the volume of the Paleontology of New York dealing with the Devonian cephalopods, and his previous doubt as to the identity of certain specimens which he described earlier seems to indicate that he never had access to them.

The specimens which Hall attributed to *Orthoceras constrictum* are not conspecific with the specimen which Vanuxem figured. The constriction on Hall's specimen is longer and much less pronounced, and the living chamber is much longer in proportion to its basal diameter than in the specimen figured by Vanuxem. In the same work Hall figured living chambers of *O. exile* and *O. subulatum* either of which might be the same as Vanuxem's *O. constrictum.* Under these circumstances it seems that a new specific name must be proposed for Hall's specimens. It appears moreover that Dr. Miller has proposed a new name for a perfectly legimate species, but one to which, however valid it might be, no specimen can be referred with certainty.

Clarke[30] in a faunal list, mentions *Orthoceras constrictum* Conrad as occurring in the Cherry Valley limestone. It is not possible to state definitely what specimens he had in mind when he wrote this, but in the New York State Museum there are several specimens from the Cherry Valley limestone which are labeled

---

[30] Clarke, J. M., **Ibid,** p. 125.

Orthoceras constrictum Vanuxem, and it appears that these specimens were so labeled under the direction of Dr. Clarke. They are conspecific with *Striacoceras typum.* From this is would appear that Clarke was in error in referring the species to Conrad, and that it was Vanuxem's species which he really had in mind. Annulated orthoceracones, which Clarke might have referred to Conrad's species do occur in the Cherry Valley, but apparently no such specimen was available to Clarke, as there are none in the New York State Museum, of which Dr. Clarke was the director at the time that he made his study of the Marcellus.

Hall's early descriptions of *O. constrictum* were based in part upon Vanuxem's figure, which he reproduces, and numerous specimens. From his description it appears that at that time Hall included in that species forms which were later figured as *O. subulatum, O. exile,* and *O. spissum,* as well as the specimens described as *O. constrictum* in the Paleontology of New York.

Michelinoceras novboracense Flower

Orthoceras constrictum Hall, J., 1879, Paleontology of New York, vol. 5, pt. 2, p. 288-89, pl. 84, fig. 13-16; pl. 85, fig. 5; possibly pl. 85, fig. 10, 11, 13; Not *Orthoceras constrictum* Conrad, 1838, Nor *Orthoceras constrictum* Vanuxem, L. 1842.

Orthoceras constrictum Grabau, A. W., and Shimer, H. W., 1910, North American Index Fossils, vol. 2, p. 51-52, fig. 1251.

This is a new name for *Orthoceras constrictum* Hall, which as has been pointed out above is not conspecific with either the specimens Conrad referred to that species or those to which Vanuxem incorrectly applied that name. The species is characterized by a very long and slender living chamber which bears near the aperture a very slight elongate constriction. The section is circular, the siphuncle is central, and the sutures are transverse. Nothing is known concerning the structure of the siphuncle, the depth of the cameræ in the ephebic portion, or the structure and ornamentation of the shell.

Types.—Lectotype: American Museum of Natural History, no. 4941/2, type of the Paleontology of New York, vol. 5, pt. 2, pl. 85, fig. 5. The types of pl. 84, fig. 13-14 appear to be conspecific, but it is doubtful whether the other specimens figured on pl. 85 are identical.

Occurrence.—The lectotype is from the Hamilton shales near Hamilton, N. Y. This species has been collected from the Windom member of the Moscow at Portland Point, Tompkins, Co., New York, and probably has a very considerable range in the Hamilton, both geographically and stratigraphically.

DIAGOCERAS Flower, gen. nov.

Genotype: Orthoceras aptum Hall

Slender orthoceracones with a circular or depressed section and a gradual rate of expansion. The sutures are oblique, and are curved slightly laterally, so that the obliquity is concentrated at the sides and the dorsum and venter are nearly transverse. The siphuncle is slightly eccentric in the genotype. If, as is assumed, it is located closer to the ventral side of the conch, the sutures slope adapically on the dorsum.

The septal necks are short, and are very faintly recurved, so that they turn at an angle of about 110 degrees. The connecting rings are poorly preserved, but appear to expand only slightly in the cameræ. Circumferential deposits are present and well developed. The surface of the internal mold is without the three vertical carinæ which characterize *Striacoceras typum* with which the genotype is sometimes confused. The surface of the shell bears minute, distant, shallow striæ with flat interspaces which are occupied by fainter lines of growth. The shell appears smooth unless examined with a lens. The mature living chamber is slightly constricted on the interior as in most orthoceracones. Aperture unknown.

Discussion.—On the basis of the ornamentation this form appears to be related to the orthoceracones of that great group which it seems best to include in *Michelinoceras* Foerste. The markedly oblique sutures separate this genus from other forms with similar ornamentation.

Diagoceras aptum (Hall) Plate 1, fig. 5-8; pl. 2, fig. 1

Orthoceras typum Hall, J., (in part,) 1876, Illustrations of Devonian Fossils: Cephalopoda, pl. 38, fig. 8.

Orthoceras aptum Hall, J., 1879 Paleontology of New York, vol. 5, pt. 2, p. 282-3, pl. 38, fig. 8.

This is a slender orthoceracone with definitely oblique sutures, and with very shallow cameræ.

The section is circular, sometimes very slightly depressed, the difference in the dorso-ventral and transverse diameters being no greater than 1.5 mm. The rate of expansion is somewhat variable, but is uniformly slight. In the holotype the rate of expansion throughout the phragmocone is 3-4 mm. in a length of 40 mm. The hypotype is slightly irregular in its rate of expansion, but it is at no point greater than 4.5 mm. in a length of 40 mm. In the mature living chamber of the holotype the rate has decreased slightly, for in the length of 71 mm. the diameter increases from 23.2 mm. to 29 mm., which would be about equal to an increase of 3 mm. in a length of 40 mm. This decrease is in part explained by the very slight constriction which is found in the outer third of the mature living chamber.

The sutures are uniformly oblique, the obliquity being concentrated laterally, and the dorsal and ventral surfaces being largely transverse, so that the sutures are slightly undulate. The cameræ are uniformly shallow. In the holotype throughout the greater length of the conch, up to a point where the diameter is 20 mm. in length, there are five or six cameræ in a length equal to the adapertural diameter. Where the rate of expansion begins to decrease, the depth of the cameræ is less modified, so that where the diameter is 23.4 mm., there are about four and one third cameræ in that length.

The siphuncle is small and is located ventrad of the center of the conch. Where the dorso-ventral diameter of the conch is 14 mm., the siphuncle is 1.3 mm. in diameter and is located 4 mm. from the ventral wall. Where the septum is 2.6 mm. in depth and the transverse diameter through the siphuncle is 12 mm., the siphuncle is 1.2 mm. in width at the septal necks which are less than .3 mm. in length and are slightly recurved. The connecting rings are very poorly preserved, but appear to expand very slightly within the cameræ, so that the diameter of the siphuncle expands at mid-heighth to 2 mm. The characters of the siphuncle and the deposits within the camerae which have already been mentioned under the generic discussion, are shown in Pl. 1, fig. 8.

A fragment of a much earlier part of the conch than has been hitherto known reveals the following characters:

Section markedly depressed in early stage, the dorso-ventral diameter 7 mm. where the transverse diameter is 9 mm. At this point the siphuncle is 1 mm. in diameter and is situated 2 mm. from the ventral side and 4 mm. from the dorsal side of the conch. The sutures are slightly oblique, but the obliquity is much less marked than in the mature portion, and is equal to about half the depth of a camera. The septum is shallow. Where the dorsoventral diameter is 7 mm. the convexity of the septum is 2 mm. on the ventral side and 1.8 mm. on the dorsum. The surface of this specimen exhibits the characteristic smooth appearance with faint lines of growth.

Discussion.—The ornamentation, the very shallow cameræ and the gradual rate of expansion are better specific criteria than the oblique sutures, for the sutures of some *Striacoceras typum* are also often oblique, sometimes from an early stage. The surface markings indicate that the species are not closely related.

Types.—Holotype, New York State Museum no. 12345/1.

Hypotypes: Pal. Res. Inst. nos. 5337-5339.

Occurrence.—In the Cherry Valley limestone at Schoharie, Stockbridge, Manlius, Marcellus and Union Springs. Not abundant.

KIONOCERATIDAE Hyatt, 1900

Orthoconic forms, sometimes slightly cyrtoconic in the young, with a central or slightly eccentric siphuncle except in *Thoracoceras,* where it is ventral and marginal in position. These forms are characterized by the ornamentation which consists of longitudinal lirae which may be variously modified in the adult. The siphuncles are straight or slightly expanding; but the septal necks are never definitely recurved.

SPYROCERAS Hyatt

Hyatt, A., 1884, Proc. Boston Soc. Nat. Hist., vol. 22, p. 276.

Spyroceras includes annulated orthoceracones in which the apical portion may be slightly curved. The ornamentation may vary considerably within the genus, but longitudinal markings always dominate and are present at an early stage, even before the annuli appear. The sutures are generally transverse, never markdly oblique, and the annuli are transverse. Foerste[31] has recently erected the genus *Metaspyroceras* for the reception of those species which possess sutures sloping adorally on the dorsum and annuli which slope adorally on the venter. The genotype is *Spyroceras ruedemanni* Foerste from the Trenton, and the group is essentially one of the early Paleozoic.

---

[31] Foerste, A. F., Black River and other Cephalopods from Minnesota, Wisconsin, Michigan and Ontario, Part 1. Denison Univ. Bull. Jour. Sci. Lab., vol. 27, p. 111. 1932.

The siphuncle of *Spyroceras* is assumed to be orthochoanitic. Its structure in the genotype is not yet known, but in the closely allied *Spyroceras caelamen* (Hall) the structure consists of short sharply recurved septal necks and subcylindrical connecting rings.

Two species are known from the Cherry Valley limestone which can be referred to *Spyroceras.* One, *S. cf. nuntium* is a typical *Spyroceras,* while the other is a representative of a somewhat different group of forms typified by the presence of cancellate markings in addition to the longitudinal liræ.

Spyroceras geneva (Clarke) Plate 1, fig. 9.

Orthoceras geneva Clarke, J. M., 1894, 13th Report New York State Geologist, for the year 1893, p. 168, pl. 2, fig. 5-7.

One specimen was found which represented the apical or nearly apical portion of a Spyroceras which exhibits surface markings identical with those of *Spyroceras geneva.*

Specimen 8 mm. in length, with diameters at the extremities of 2 mm. and 2.1 mm. It is orthoconic, and appears to be circular in cross section. At the apical extremity of the specimen a septum is exposed. This is shallow, with apparently transverse suture, and shows the siphuncle to be central. The remainder of the conch shows no traces of septa, and appears to represent a very young living chamber.

The ornamentation consists of rounded transverse and longitudinal liræ with flat interspaces. In the apical portion the transverse liræ are rather close together, there being 9 in the space of 1 mm.; adaperturally they become slightly more distant and are less regularly spaced, tending to become concentrated in the interspaces between the incipient annuli. They are slightly more distant adaperturally, there being 7 in the length of 1 mm. The longitudinal liræ are slightly stronger. Adapically there are five of these in the space of 1 mm. and they are scarcely more distant in the adapertural portion of the specimen.

The annulations are not well developed in this stage. They are low, broad and rounded, equal in extent to the rounded interspaces. The specimen bears four such annuli.

Types.—Holotype: New York State Museum, no. 12372/1.

Hypotype: Jewett Collection, Cornell University, no. 8194.

Occurrence.—*Spyroceras geneva* was described from the Onondaga limestone in the Geneva township, Ontario County. The almost identical surface markings leave little doubt but that the specimen from the Cherry Valley limestone is conspecific with Clarke's type.

Spyroceras cf. nuntium (Hall) Plate 1, fig. 4.

Orthoceras nuntium Hall, J., 1862, 15th Rep. New York State Cab. Nat. Hist., p. 79, pl. 8, fig. 3-4.
Orthoceras nuntium Hall, J., 1876, Illustrations of Devonian Fossils: Cephalopoda, explanation of pl. 43, pl. 43, fig. 4-10, 13-14.
Orthoceras nuntium Hall, J., Paleontology of New York, vol. 5, pt. 2, p. 299-300, pl. 43, fig. 4-10; 13, 14; pl. 72, fig. 14, 15.
Spyroceras nuntium Grabau, A. W., and Shimer, H. W., 1910, North American Index Fossils, vol. 2, p. 64, but not fig. 1272 on p. 65.

This is a fragment of a *Spyroceras* 21 mm. in length with diameters of 4.5 mm. and 6 mm. at the extremities. Viewed laterally, the specimen is very slightly curved, so that the supposed dorsal side is faintly concave. The section is circular.

The sutures are slightly oblique, and slope adaperturally on the ventral side. The obliquity is very slight. In a length of 5 mm. there are four cameræ.

The septa are evenly curved and shallow; where the diameter of the conch is 4.5 mm., the septum is .8 mm. in depth. At this point the siphuncle is about .6 mm. in diameter and is central in position. Its structure has not been observed.

The most conspicuous feature of the shell is the presence of the annulations. These are narrowly rounded with broad, nearly flat interspaces. In the adapical 10 mm. of the specimen there are eight annuli and seven septa.

The ornamentation consists of fine longitudinal liræ of which there are about 7 in the width of 2 mm. Adorally the liræ increase in number and are closer together, so that there are 10-13 in the width of 2 mm. There is no trace of transverse ornamentation.

Discussion.—This specimen is of interest in that it shows an adapertural increase in the number and proximity of the longitudinal liræ. The liræ do not approach the condition of *Spyro-*

ceras crotalum in their frequency, but attain that of *S. nuntium.* The Cherry Valley specimen agrees with *S. nuntium* in the frequency of the annuli, but differs from it in that no alternation of coarse and fine striæ separating the liræ can be made out.

Type.—Jewett Collection, Cornell University, No. 7962.

Occurrence.—"Goniatite limestone near Cazenovia."

STRIACOCERAS Flower, gen. nov.

Genotype: **Orthoceras typum** Saemann

Slender orthoceracones of circular section with straight, transverse or slightly oblique sutures. The siphuncle is orthochoanitic, and is situated nearer the venter than the dorsum. In the genotype the ratio of the distance of the siphuncle from the ventral and dorsal walls respectively is about as three is to four. The septal necks are short and erect, being about one-eighth the depth of a camera. The connecting rings expand slightly one-fourth the distance toward the preceding septum, but contract regularly apicad. The genotype bears pronounced circumferential deposits within the camerae, even in immature specimens. The siphuncle is empty.

The living chamber is of moderate length and bears, in the immature conch, an internal thickening of the shell near the aperture which results in a constriction of the internal mold. The aperture bears a very broad and shallow hyponomic sinus.

The genus is characterized by its ornamentation. In the early portions of the shell the markings consist of equally spaced, transverse and longitudinal rounded liræ. In the late neanic stage the transverse liræ are unmodified, but the longitudinal liræ are widely separated and finally disappear. In the ephebic portion, the transverse liræ become broad and flattened, so that the final stage in ornamentation shows rather irregular transverse striæ impressed upon an otherwise smooth surface.

The internal mold bears three ventral carinæ and is rarely faintly faceted.

Discussion.—This genus is related to the Kionoceratidæ as is shown by the early ornamentation, and appears to be a descendant of *Protokionoceras* Grabau and Shimer, of the Silurian. The genotype of *Striacoceras* was included under *Protokionoceras* in the original description of that genus[32].

Striacoceras typum (Saemann) Pl. 2, fig. 2, 3, 6, 7, 9; Pl. 3, fig. 1-7; Pl. 4, fig. 3-4, 7-9; Pl. 5, fig. 1, 6; Pl. 6, fig. 7, Pl. 7, fig. 2, Pl. 8, fig. 7, Pl. 9, fig. 3, 4, 11, 12.

Orthoceras typus Saemann, L., 1853, Paleontographica, Dunker and Von Meyer, bd. 3, p. 165, pl. 20.

Orthoceras marcellensis Hall, J., 13th Rep. New York State Cab. Nat. Hist., p. 106.

Orthoceras typum (in part) Hall, J., 1876, Illustrations of Devonian fossils: Cephalopoda, explanation of pl. 38, fig. 4-9, pl. 38, fig. 4-7, 9.

Orthoceras Marcellense Vanuxem, L., 1877, Cat. American Paleozoic fossils, S. A. Miller, p. 175.

Orthoceras Marcellense Hall, J., 1879, Pal. New York, vol. 5, pt. 2, p. 278-81, pl. 38, fig. 4-7 9; pl. 83, fig. 1-10, 12; pl. 103, fig. 18.

Protokionoceras marcellense Grabau, A. W., and Shimer, H. W., 1910, N. A. Index Fossils, vol. 2, p. 60, fig. 1264.

This is the species widely known in America as *Orthoceras marcellense* Vanuxem. The change in name deserves some explanation. Vanuxem's[33] original description reads as follows: " . . . a large Orthocera, the *marcellus*, which sometimes attains a diameter of a foot." Vanuxem's type has gone the way of his other specimens, but for once this does not matter, for Vanuxem, however obvious was his intention to supply popular or colloquial names by a reversal of the scientific names, failed here to give a good binomial name. The first description of this species under an acceptable scientific name was that of Saemann. His description and figure are sufficient to prove that his species is identified with that described and figured by Hall and Vanuxem as *Orthoceras marcellense.*

The specimens which Saemann figured are in Europe if they are preserved, and are hardly accessible to American workers. Consequently the selection of a lectotype has not been feasible, save as it would seem that the type of Saemann's pl. 20, fig. 1a should serve as such. Saemann reports that his specimens came from near Cazenovia, N. Y., but no outcrops of the Cherry Valley are known there at present, nor were they known to Hall[34], who suggests that the locality might well be an error. There can be no doubt, however, but that the specimen came from the Cherry Valley Limestone, for Saemann reports that it occurs in association with a large goniatite, and with as large *Apioceras*[35].

---

[32] Grabau, A. W. and Shimer, H. W. North American Index Fossils, vol. 2, p. 1262. 1910.

[33] Vanuxem, L. Geology of New York, vol. 3, Rep. of the Third District, p. 147. 1842.

[34] Hall, James. Paleontology of New York, vol. 5, pt. 2, p. 281. 1879.

From the assembling together of a large series of specimens of Cherry Valley orthoceracones attributed to this species, and from the examination of the very fine specimens in the New York State Museum, it is evident that this species is a highly variable one, and it is also possible to demonstrate the intergradation of the various forms. From these, we have selected several specimens which differ markedly from one another, and which we have described as variants.

Description.—Orthoceracones of circular section; generally slender, but with a highly variable rate of expansion, which may vary in portions of the phragmocone not affected by the gerontic reduction in the rate of expansion from 2 mm. in a length of 40 mm., to 7 mm. in that length. The mature living chamber and the adoral portion of the mature phragmocone expand more slowly than the earlier part of the conch. In the apex the rate of expansion is slight, and in general it is greatest in the middle portion of the phragmocone.

The sutures may be transverse in the young, but are normally slightly oblique in the ephebic portion. In some forms the obliquity occurs at an early stage, and such forms are apt to be confused with *Diagoceras aptum,* from which they can be separated by the surface markings, the greater depth of the cameræ and the greater rate of expansion. The cameræ vary markedly in depth among the variants. There may be two cameræ in a length equal to the adoral diameter, or there may be four and a half. The siphuncle is central or subcentral in the young, where the diameter of the conch is 6 mm. or less. In the mature portion the siphuncle is slightly eccentric, the ratio of its distances from the dorsal and ventral walls respectively being as four is to three. The depth of the septum is variable, but is from one-third to one-fourth the diameter of the conch. The siphuncle in longitudinal section is orthochoanitic, with moderate septal necks which are about one-ninth the depth of the camera. The remainder of the length is made up of the connecting ring, which expands slightly one-fourth the distance to the preceding septum, and contracts gradually apicad from that point. Natural sections have a cyrtochoanitic aspect which is more apparent than real, and is caused by the relatively thick septal neck which causes the interior of the siphuncle to contract slightly. This is more marked in the younger stages than in a section of a mature portion. The relation of the diameter of the siphuncle to the diameter of the conch is as one is to seven in the mature portion, but in the earliest stage sectioned, the siphuncle is nearly one-fourth the dorso-ventral diameter. (Pl. 7, fig. 2.)

---

[35] Probably **Agoniatites vanuxemi** and **Poteriocerina solidum.**

The interior of the cameræ bears pronounced circumferential deposits, which are more strongly developed on the ventral side than on the dorsal side. The surfaces of these deposits are sometimes shown in weathered specimens, the deposits adhering to the shell and coming off with it, leaving the sediment-filled open space around the siphuncle. Such deposits normally exhibit a definitely bilaterally symmetrical pattern which leads to the belief that they were secreted by a living membrane, a functional mantle, which lined the camerae and which must have had some connection with the other soft parts of the animal, either through the siphuncle, or through the dorsal carina of the internal mold. In relation to this dorsal carina it might be noted that a similar structure is found on the venter of some other forms, and it may be that we have been regarding the wrong side of this form as the venter, though it is on this side that the aperture bears a broad low sinus which appears to be the hyponomic one, and the remainder of the aperture is straight.

The deposits are formed in the cameræ some time after the cameræ have been set off from the living chamber. When it is possible to section a number of successive cameræ, it is found that the deposits are more pronounced in the apical region. In no case have deposits been found in the cameræ adjacent to the living chamber. Teichert[36] suggests that in the actinoceroid cephalopods the deposits are formed only after maturity, and that the young stage was probably pelagic.

We have found deposits pronounced in immature specimens of *Striacoceras typum* which indicate that here at least, the organism was probably benthonic throughout the greater part of its life.

---

[36] Teichert, Curt. Der Bau der Actinoceroiden Cephalopoden. Paleontographica, bd. 78, abt. A, p. 111-230, pl. 8-15. 1933.

The three ventral carinæ of the internal mold and the dorsal carina which is shown in some specimens have not been adequately explained. Sometimes the internal mold is faintly faceted on the venter, and both the facetings and the ventral carinæ might be characters which hearken back to the kionoceroid ancestry of this form. The dorsal carina is quite different, and resembles the structure found on the "venter" of some of the Schoharie Grit forms, notably "*Orthoceras*" *luxum* Hall[37].

The ornamentation is as described for the genus. The fine cancellate ornamentation is confined to regions having a diameter of less than 10 mm., and is best developed under a diameter of 5 mm. The longitudinal liræ may persist as faint ridges appearing as angles on an obscurely faceted surface up to a diameter of 20 mm., but the condition is rare. Such a condition occurred in one of Hall's types (New York State Museum no. 12381/1,) and the liræ were greatly exaggerated[38] in the drawing of the enlargement of the surface. A photograph of this specimen, showing an enlargement of the portion of the surface on which Hall appears to have based this figure is shown in pl. 2, fig. 7. The transverse liræ are normally broad and flat some distance before the base of the mature living chamber, though this varies in individuals. At this stage the striæ are irregularly undulate and anastomose in a characteristic manner. (Pl. 2, fig. 6.)

Pathological conditions and injuries.—Breaks in the shell have already been reported from cephalopods. These result in a slight but temporary modification of the ornamentation. On pl. 9, fig. 12 is figured a specimen which shows an abnormal condition of the septum which appears to be pathological. This septum occurs at the base of the living chamber, and is preceded by a perfectly normal septum. A slight modification of the suture is shown in pl. 2, fig. 9, which seems to be pathological. Another irregularity occasionally met with, though it may not be pathological, is the failure to secrete a septum at the proper time. (pl. 2, fig. 2.)

---

[37] See Hall, Paleontology of New York, vol. 5, pt. 2, p. 244-48, pl. 35, fig. 5-6. 1879.

[38] Hall, Ibid., pl. 37, fig. 9.

Types.—The location of the lectotype is not known. It appears that Hall's types, inasmuch as they added greatly to the knowledge of the species, should be given the status of hypotypes which should not be affected by the necessary change of the specific name, particularly since Hall recognized Vanuxem's and Saemann's species as identical. These types are deposited in the New York State museum, no. 12381/1-7 and American Museum of Natural History, no. 4411/1. Four specimens are included under this last number. In addition, the specimens which we designate as the variants and figure as such are hypotypes of *S. typum,* Pal. Res. Inst., no. 5340-5360.

Occurrence.—In the Cherry Valley limestone, abundant from Schoharie to Union Springs, with strays occurring outside this area. The specimens attributed to this species from the Hamilton shales may or may not be identical. It has not been possible to locate them. Cooper and Williams[39] reported this species from the Tully limestone. The specimen referred to this species was kindly loaned me for examination. It appears to be distinct from *S. typum* on the basis of the outline of the siphuncle, which shows a slight but definite area of adnation which has not been observed in *S. typum.* This specimen cannot be referred to any genus with certainty.

Explanation and summary of the variants.—The variations which occur within *Striacoceras typum* result in some specimens which would be regarded as distinct species were it not for other specimens which filled in the apparent gaps. The forms intergrade to such an extent that they cannot be regarded as species, subspecies or genetic mutants. Their contemporaneity precludes the possibility of geologic mutants. Here is a situation in which forms are significant and deserving of description and mention seem to have no previous provision made for them. I have used the term variant, and that the nomenclature may not become too involved, I have designated these by Greek letters. In the selection of types I have chosen extremes, and it has not been possibl to figure and describe the countless intermediate forms. Let it suffice to say that as many more variants could be described were there any point in doing so. For those who wish to label specimens to show their relation to the various forms, I can only suggest such designations as "intermediate between alpha and beta," or "close to alpha." The variants are described partly because some of the variations were significant and it was desirable to have a name to apply to them, and partly to call attention to the various extreme differences as such which are possible within a species .

---

[39] Cooper, G. A. and Williams, J. S. Tully formation of New York. Geol. Soc. America, Bull., vol. 46, p. 859. 1935.

A word should be said concerning the place of Saemann's types in this scheme. The two larger specimens, (fig. 1a, c,) represent conchs with a rate of expansion as great as that of most forms, but with only two cameræ in a length equal to the adapertural diameter. The last character alone would place this in variant *epsilon,* but the rate of expansion is too great. Further, this variant is rare and at present is known to me only from small fragments of the phragmocone. Considering the greater rate of expansion than is typical, it seems highly probable that the depth of the cameræ has been exaggerated in the drawing, and that this form should lie close to variant *gamma.*

Summary of variants:

alpha.—Rate of expansion relatively great; normally 4 mm. in a length of 40 mm.; four cameræ in a length equal to the adapertural diameter; gerontic constriction at a relatively early stage, beyond a maximum diameter of 35 mm. Sutures oblique in mature stage; often oblique in early stage as well.

beta.—Slightly less rapidly expanding, and attaining a larger size. Constriction beyond a diameter of not less than 40 mm.; three and a half to four cameræ in a length equal to the adapertural diameter.

gamma.—A large form with a gradual rate of expansion of usually 2-3 mm. in a length of 40 mm., rarely 4 mm. in that length locally. There are three cameræ in a length equal to the adapertural diameter; possibly rarely three and a half. The sutures are transverse or very slightly oblique in the mature conch. The constriction occurs beyond a diameter of not under 40 mm., usually not over 45 mm.

delta.—Incompletely known; a greater rate of expansion, of 4 mm. in a length of 40 mm., and shallower cameræ, so that there are two and a half to three cameræ in a length equal to the adapertural diameter.

epsilon.—Known only from fragments. There are only two cameræ in a length equal to the adapertural diameter, and the rate of expansion appears to be slight, certainly not over 3 mm. in length of 40 mm. The dorsal carina is often clear on this form, and deposits are well developed.

Striacoceras typum variant **alpha** Pl. 3, fig. 2; Pl. 4, fig. 8; Pl. 6, fig. 7.
Flower, new variant

Under this variant are included relatively small forms which have a rate of expansion of 4 mm. in a length of 40 mm. or sometimes more. This decreases only when approaching the gerontic condition which is marked by a decrease in the rate of expansion followed by an internal constriction just before the aperture. There are four cameræ in a length equal to the adapertural diameter throughout the greater part of the phragmocone; this will be slightly less in the extreme apical part, for the cameræ expand more slowly than does the conch in the neanic portion, and slightly more in the last four or five cameræ before the mature living chamber, for the cameræ here are shallower. The sutures are characteristically oblique, even in the young part of the conch.

They slope adaperturally on the dorsal side as in *Diagoceras aptum.* In the young stage the septa are very shallow; being 2.8 mm. in depth where the diameter is 13 mm. The septum increases rapidly in depth, however, for a little farther on in the same specimen it is 6 mm. where the diameter is 18 mm. This proportion varies but little in the later parts of the phragmocone.

The living chambers of this form are typically of rather small size. The diameters at the base vary from 30 mm. to 35 mm. The living chamber when complete is slightly less than two and one-half times the basal diameter in length

The ornamentation as revealed by this variant shows the longitudinal liræ confined to a very early part of the conch. In the holotype the ornamentation which characterizes the adult *Striacoceras* occurs at a diameter of 13 mm.; there are narrow striæ with broad flat interspaces. (pl. 2, fig. 6.) There are about 34 of these striæ in the length of 5 mm. at this region. In an equal length there are about 25 such striæ, 5 mm. before the aperture. In the last 5 mm. the striæ are crowded and very close together, so that the interspaces are no longer broad and flat.

For purposes of comparison the measurements of the figured specimens are given below:

Holotype: Length 300 mm. Phragmocone 50 mm. to base of living chamber. In this region the conch expands from 13 mm. to 35 mm. Sutures poorly exposed, apparently oblique, four in a length equal to the adapertural diameter. Gerontic cameræ not visible. The living chamber is 35 mm. across the base and is 90 mm. in length. In the first 60 mm. the diameter expands evenly to 40 mm. This is followed by an internal constriction which occupies a length of 13 mm. The diameter of the internal mold at the middle is 37 mm. 20 mm. beyond is the aperture which bears a hyponomic sinus which occupies the greater part of the ventral surface. Diameter at aperture, about 43 mm.

Paratype: Specimen 185 mm. in length, of which 105 mm. pertains to the phragmocone. The conch expands from 19 mm. to 32 mm. in this region. The rate of expansion varies between 4 mm. and 5 mm. in a length of 40 mm. The cameræ vary erratically in depth, so that in the lower half of the phragmocone, which cannot be affected by gerontic modification, there may be from four to five cameræ in a length equal to the adapertural diameter. The septum is about one-third the diameter of the conch; where the diameter is 19 mm., the septum is 6 mm. in depth. The siphuncle is very slightly eccentric. The sutures are strongly oblique in this specimen. The living chamber is 78 mm. in length, 32 mm. across the base. The diameter expands to 35 mm. at a point 48 mm. above the base. This is followed by a constriction which is shallow and which is 20 mm. in length. The aperture lies about 12 mm. beyond the cessation of the gerontic contraction.

Paratype: An early stage with oblique sutures. There are four camerae in a length equal to the adapertural diameter throughout. Where the diameter is 13 mm., the septum is 2 mm. deep on the venter and 3 mm. deep on the dorsum. 33 mm. farther toward the aperture the diameter is 13 mm. and the depth of the septum is 6 mm.

Types.—Holotype: Pal. Res. Inst., no. 5340; paratypes: Pal.

Res. Inst., no. 5341-42.

Striacoceras typum variant beta Flower, new variant

Pl. 3, fig. 3-5, 7; Pl. 4, fig. 7.

This is a relatively large form, with a moderate rate of expansion and sutures which may appear transverse or be slightly oblique. The rate of expansion is more gradual than that of *alpha,* with which this form agrees in possessing normally four cameræ in a length equal to the adapertural diameter, though forms in which there are three and a half cameræ in that length seem to belong here also. This condition is variable and occurs as an erratic character in some specimens.

Holotype: Specimen 240 mm. in length; of which 105 mm. pertain to the phragmocone. This expands in that length from 28 mm. to 35 mm. The conch expands at a rate of 3-4 mm. in a length of 40 mm. The phragmocone has four cameræ in a length equal to the adapertural diameter of the section, or it may have three and a half in this length. The variation is irregular and erratic. The septa are slightly more than one-third their diameter in depth. Where the diameter is 26 mm. the septum is 9 mm. deep; where it is 32 mm. the depth is 11 mm.

The living chamber is complete and is 134 mm. in length. In the first 75 mm. the diameter increases regularly from 35 mm. to 40 mm. Beyond this point the constriction appears. The outline of the interior contracts rapidly adaperturally and expands slowly adaperturally so that the former diameter is not resumed for a length of 40 mm., 20 mm. before the aperture. The specimen is peculiar in the length of the living chamber which is three and a half times the diameter at the base.

Paratype: This represents an immature individual which attains considerable size. The immature condition is shown by the absence of the internal constriction of the living chamber, the slight increase of the rate of expansion on the living chamber, and the regular increase in depth of the adapertural cameræ.

The phragmocone is 85 mm. in length, and increases in diameter in that length from 29 mm. to 35 mm., the rate of increase being 2.5/3 mm. in a length of 40 mm. The sutures are transverse and straight. There are three to four cameræ in the length equal to the adapertural diameter; where the diameter is 31 mm. there are four cameræ in that length; where the diameter is 35 mm., there are three and a half cameræ in that length. The septa are normal, about one-third the diameter, in depth. The living chamber is 93 mm. in length, and increases from 35 mm. to 42 mm. in diameter in that length. This specimen shows a very gradual rate of expansion and cameræ in which there is no trace of deposits.

Types.—Holotype, Pal. Res. Inst., no. 5343; Paratype, Pal. Res. Inst., no. 5344.

Occurrence.—In the Cherry Valley Limestone. The types are from Stockbridge. We have seen specimens from Manlius and Schoharie which fall into this group.

Striacoceras typum variant **gamma** Pl. 3, fig. 1; Pl. 4, fig. 9.
Flower, new variant

This is a form which attains a large size, has a gradual rate of expansion, normally of 2-3 mm. in a length of 40 mm., and which has three cameræ in a length equal to an adapertural diameter. The sutures are only faintly oblique, the septum is about one-third its diameter in depth, and the living chamber is slightly less than two and one half times the basal diameter in length. The gerontic contraction is broad and slight.

Holotype.—Section circular. Rate of expansion 3 mm. in a length of 40 mm., but decreasing to 2 mm. in that length beyond a diameter of about 38 mm. The specimen is 300 mm. in length, of which 205 mm. pertains to the phragmocone. The diameter expands in this length from 22 mm. to 40 mm. Throughout the phragmocone, except in the last four cameræ, there are three cameræ in a length equal to the adapertural diameter. At the base of the living chamber there are four cameræ in such a length. The living chamber is 100 mm. in length. 60 mm. above the base the diameter is 46 mm. The constriction begins beyond this point. The diameter at the supposed aperture is 45 mm.

The paratype shows almost identical measurements. This specimen is the basis of the erronious conception of the persistence of the longitudinal liræ on the surface of the shell. The region of the shell upon which Hall based his pl. 38 fig. 9 bears only very faint angles to obscure faces. (pl. 2, fig. 7.)

The ornamentation near the aperture is that of a typical *Striacoceras.*

Types.—Holotype, Pal. Res. Inst. no. 5345; paratype, New York State Museum, no. 12381/1.

Occurrence.—In the Cherry Valley limestone from Manlius to Schoharie. The holotype is from Stockbridge, the paratype from Manlius.

Striacoceras typum variant delta Flower, new variant Pl. 3, fig. 6.

This form is known from a single specimen which is incomplete. It consists of a well preserved portion of the phragmocone, weathered fragments of the adapertural cameræ, and a weathered and incomplete living chamber. The description is based largely upon the well preserved part of the phragmocone.

This is a representative of a group of uncommon forms, those which have deep cameræ and a great rate of expansion. The specimen is 82 mm. in length, and expands from about 18 mm. to 27 mm. in that length. The rate of expansion is about 4 mm. in a length of 40 mm. The sutures are transverse and straight. There are two and a half cameræ in a length equal to the adapertural diameter of 26 mm., and three in a length equal to the adapertural diameter of 20 mm. The condition of the mature living chamber is unknown.

Types.—Holotype, Pal. Res. Inst., no. 5346.

Occurrence.—In the Cherry Valley limestone at Stockbridge.

Striacoceras typum variant epsilon Pl. 5, fig. 6; Pl. 9, fig. 3, 11.

This is known only from a few fragments of the phragmocone. It is characterized by remarkably deep cameræ of which there are two in a length equal to the adapertural diameter of the section. The rate of expansion appears to be close to that of the preceding, about 2 mm. in a length of 40 mm., perhaps slightly less. The dorsal carina is usually well developed, the septum is 7 mm. in depth where the diameter is 15 mm. This offers a sharp contrast to the condition of *alpha,* in which the septum is less than one third the diameter of the conch in a corresponding stage. This is, however, very close to the preceding, which has a gradual rate of expansion but possesses three cameræ in a diameter in which this has two. The condition of the living chamber is unknown. The sutures appear to be perfectly transverse and straight.

Types.—Holotype: Pal. Res. Inst., no. 5347.; paratype: New

York State Museum, no. 12381/4.

Occurrence.—In the Cherry Valley limestone, at Manlius and Stockbridge.

Striacoceras kionoceroides Flower sp. nov. Pl. 2, fig. 5; Pl. 9, fig. 5.

This species is known only from a few fragments.

Conch circular in section, the diameter expanding from 22 mm. to 24.5 mm. in a length of 40 mm. There are three cameræ in a length equal to the adapertural diameter as in *Striacoceras typum* variant *gamma.* The septum has a depth of about one-third the diameter; where the diameter is 21 mm., the septum is 7 mm. deep. At this point the siphuncle is only slightly eccentric. Where the diameter of the conch is 22 mm., the siphuncle is 3 mm. in diameter and is separated from the ventral wall by 8.5 mm. and is 11 mm. from the dorsal wall. The structure of the siphuncle is unknown, but is probably similar to that of *Striacoceras typum.* The sutures are transverse and straight.

The ventral side of the conch is located by a median carina on the internal mold. One of the lateral carinæ is also present; the other is covered by the shell in the holotype.

The ornamentation consists of transverse liræ of which there are sixteen in 4 mm. which are so festooned at intervals of about 10 in 4 mm. that it is clear that the longitudinal lirae have persisted to a very late stage. In favorable portions of the specimen there are faint vertical liræ between the transverse liræ in the festooned area. The diameter of the conch at this point is 23 mm. The traces of longitudinal liræ persist into the mature living chamber as faint facetings on the surface, so that where the diameter is 35 mm. the condition of ornamentation which is found in *S. typum* where the diameter is about 18 mm. is almost exactly duplicated.

Discussion.—This species represents a more primitive condition of *Striacoceras* than does *S. typum.* The ornamentation is the most characteristic feature of the species, and one which will separate this species from all known variants of *S. typum.* The rate of expansion and depth of the cameræ is close to that of *S. typum* variant *gamma.* The siphuncle is slightly less eccentric than in any specimens of *typum* of a corresponding diameter.

Types.—Holotype: Pal. Res. Inst., no. 5361. Paratype: Pal.

Res. Inst., no. 5362.

Occurrence.—In the Cherry Valley limestone at Stockbridge.

Family RHYTICERATIDAE Hyatt 1883

Cyrtoceracones and gyroceracones, depressed somewhat in section, with a ventral orthochoanitic siphuncle. The family is characterized by a thick, strongly ornamented test which bears either frills or localized spout-like or spinous processes. Hyatt[40] describes the siphuncle as more or less nummuloidal, but the apparent numuloidal appearance in weathered specimens is deceptive as sections show good orthochoanitic structure. Hyatt[41] included here the genera *Rhyticeras, Cophinoceras* and *Strophiceras* which are confined to the middle Devonian.

TETRANODOCERAS Flower, gen. nov.

Genotype.— *Cyrtoceras transversum* Hall.

Gyroceracones of greatly depressed section, the ratio of the dorso-ventral and transverse diameters ranging between 2:3 and 3:4. The dorsum is transverse, scarcely elevated, and not distinctly separated from the sides which are slightly convex; converging vertically toward the ventral face which is about one-third the greatest width of the conch. The venter is set off from the sides by nodes in the neanic stage and by well defined abdominal angles in the ephebic stage.

The genus is characterized by the possession at the ephebic stage of four pairs of tubercles or blunt spines which are reflected upon the interior by low nodes, though in the gerontic stage the tubercles tend to become solid and their presence cannot be detected from the internal mold. The tubercles are distributed as follows:

1. A pair of nodes upon the abdominal angles which develop into revolving striae on the surface and abdominal angles upon the interior.

2. A pair of ventro-lateral nodes. In the genotype these are visible on the interior only in the early stages, but are more persistent on the surface.

---

[40] Hyatt, Alpheus. **Cephalopoda** in Zittel-Eastman Textbook of Paleontology, 1st. ed., vol. 1, p. 522. 1900.

[41] Hyatt, Alpheus. Proc. Boston Soc. Nat. Hist., vol. 22, p. 284. 1883.

3. A pair of lateral nodes, the most persistent of all.
4. A pair of dorso-lateral nodes.

The sutures show broad shallow dorsal lobes, but are otherwise transverse, except for local modification at some of the nodes.

The shell is thick. The surface markings consist of fine longitudinal liræ and coarse transverse undulating striæ. These striæ are modified ventrally by the hyponomic sinus, the abdominal angles and the various lateral tubercles. At these tubercles the shell is greatly thickened, but they do not appear to be spout-like, as in *Ptenoceras* Hyatt[42] or *Cophinoceras* Hyatt[43].

The genotype shows marked gerontic conditions which may also be characteristic of the other species. Besides the solidification of the tubercles, the internal mold undergoes a ventral constriction comparable to the constriction common in orthoceracones, which results in the loss of the ventral face for a brief space, it being replaced instead by a ventral ridge. The ventral face is regained in the latest stage known, but the whole section is more gibbous ventrally than in the ephebic conch.

Discussion.—This genus differs from *Cophinoceras* Hyatt in possessing four pairs of nodes instead of three, and in having a more definitely depressed section. It differs from *Ptenoceras* Hyatt and its allies in having the tubercles solid and not spout-like, and in having an orthochoanitic and empty siphuncle.

But two species are known to the author which belong in this genus. Besides the genotype, there is *Gyroceras constrictum* Meek and Worthen[44], which is very closely allied to *T. transversum,* but which, according to the published figure, possesses more persistent ventro-lateral and dorso-lateral nodes on the internal mold in the ephebic stage. This species is known from the Hamilton of Jackson County, Illinois.

Tetranodoceras transversum (Hall), Pl. 2, fig. 8; Pl. 6, fig. 1-5; Pl. 7 fig. 1.

Cyrtoceras transversum Hall, J., 1860, 13th Rep. New York State Cab. Nat. Hist., p. 104.

---

[42] Hyatt, A. Proc. Amer. Phil. Soc., vol. 32, p. 491, 1894.

[43] Hyatt, A. Proc. Boston Soc. Nat. Hist, vol. 22, p. 285, 1883. 1868.

[44] Meek and Worthen, Geol. Surv. Illinois, vol. 3, p. 446, pl. 12, fig. 1a, b.

Gyroceras transversum Hall, J., 1876, Illustrations of Devonian Fossils: Cephalopoda, pl. 57, fig. 1-4.
Gyroceras transversum Hall, J., 1879, Paleontology of New York, vol. 5, pt. 2, p. 385-85, pl. 56, fig. 1-4.

Description.—A large gyroceracone. Mature individuals must have described more than two complete revolutions and the diameter of such specimens must have been about 15 inches.

Section depressed throughout, the proportions varying from 4:5 in the young to 3:5 in the mature conch. The rate of expansion is moderate, the transverse diameter increasing more rapidly than the dorso-ventral diameter. The following dimensions will illustrate this:

Diameters	Length between points where measurements were taken.
13 x 16 mm.	
	78 mm.
24 x 35 mm.	
	61 mm.
28 x 47 mm.	
	234 mm (?)
37 x 54 mm.	
	?
52 x 78 mm.	

The length is measured along the venter.

The septa are shallow, with the point of greatest convexity slightly nearer the dorsum than the venter. Where the diameters of the conch are 13 and 16 mm., the septa are 3 mm. deep. Where the diameters are 28 and 47 mm., the depth of the septum is 8 mm. The siphuncle is small, tubular, and is located close to the venter but not in contact with it. Where the dorso-ventral diameter is 13 mm. the siphuncle is about 1.4 mm. in diameter, and is slightly less than 1 mm. from the ventral wall. Where the dorso-ventral diameter of the conch is 34 mm., the siphuncle is 4.6 mm. in diameter at its passage through the septa. The septal necks are straight and very short. They extend scarcely more than .5 mm. into a cameræ which is 7.5 mm. in depth. The connecting rings expand very slightly one-third the distance to the preceding septum to a diameter of 5 mm., and contract again adapically. (pl. 6, fig. 3.)

The cameræ are uniformly shallow. In a length measured along the venter equal to an adapertural diameter of 19 mm., there are four cameræ. The same number of cameræ is found in a length equal to the adapertural diameter of 34 mm. The cameræ contract slightly in the gerontic portion.

The ornamentation of the exterior is known only for the gerontic portion of the shell. It can be inferred on the young shell from the characters of the internal mold and a few isolated shell fragments. The surface of the shell, wherever present, shows conspicuous transverse undulate liræ and striæ alternating. The venter is marked by a series of four pairs of nodes on the internal mold which represented short blunt spinous projections on the surface of the shell. These nodes occur regularly in rings at even but rather rapidly increasing intervals. In the neanic stage where the diameter is 13 mm. the nodes occur at about every other camera. They are found on every third camera where the dorso-ventral diameter is 26 mm., and this increases to every fourth camera in the latest stage known.

The three lateral nodes occur at the same level, but the nodes of the abdominal angles occupy a slightly more adapical position. The abdominal nodes grade into continuous abdominal angles on the interior, and the spines of the exterior become revolving liræ where the dorso-ventral diameter is 28 mm. At about the same point the ventro-lateral nodes become indistinguishable. The dorso-lateral nodes disappear internally at a point where the diameter is 36 mm. Only the abdominal angles and the lateral nodes remain well defined to the gerontic stage. The exterior, as is shown from the external mold of a gerontic specimen, does not change as markedly as the disappearance of the nodes of the interior might lead one to believe. Instead the dorso-lateral and ventro-lateral spines of the exterior have been filled in so solidly that they are no longer reflected internally.

The aperture bears a well defined hyponomic sinus. Where the diameters of the conch are 52 and 78 mm., the sinus is 30 mm. across and 11 mm. in depth. The dorsal margin is transverse but the lateral margin bears incipient nodes and is slightly excavated between them. This indicates that the nodes represent resting stages in the growth of the shell and are comparable to the varices of growth of the Gastropoda.

The gerontic characters other than the filling in of the spines are known from the lectotype and from a hypotype. The former shows in one portion the replacement of the abdominal face by a mid-ventral ridge. This occurs in the earliest part of the specimen in question, and persists throughout the length of five cameræ. The next two show a return to the normal condition and over the next five cameræ and the entire living chamber there is a gibbous abdominal face with rather poorly defined angles. The depth of the cameræ, the position and clarity of the nodes and the condition of the surface markings all indicate that this is conspecific with the other specimens which have been referred to this species It seems that the appearance of the mid-ventral ridge signifies a gerontic internal thickening of the shell which is localized some distance from the latest known aperture, as are similar internal thickenings in orthoceracones. In such gerontic specimens expansion, both dorso-venetrally and transversely, is negligible. There is a slight though not marked contraction of the cameræ, so that there are five in a length equal to an adapertural dorso-ventral diameter.

The living chamber is unusually short, scarcely greater than the dorso-ventral diameter at the base. Where the diameters are 52 and 78 mm., the living chamber is 65 mm. in length. Where the dorso-ventral diameter is 38 mm. the living chamber is 46 mm. in length.

Discussion.—This species was first recorded by Hall from the Cherry Valley limestone at Manlius, and has been known only from fragments of mature and gerontic portions of the living chamber and phragmocone. The above description is based upon Hall's types, one unfigured specimen in the New York State Museum, and two specimens in the collection of the author; one representing the earlier portion of the shell of this species, which has hitherto been unknown, the other representing the latest known stage of the aperture. The preservation of the former deserves mention. It was found in the Cherry Valley limestone at Wood's quarry, Union Springs, and was found partially weathered out of a block of the limestone which was still in place. This specimen contains in all 54 cameræ and a nearly complete living chamber, describing one and one quarter volutions. The ventral portion of the living chamber was not well enough preserved to allow any definite assertion concerning the presence or absence of gerontic characters to be made. It is possible that this specimen, occuring as it does near the westward limit of the species, might be slightly dwarfed as is the *Striacoceras* with which it was associated, though the matter is open to doubt as a specimen of *Centroceras marcellense* from the same place showed no such tendency. The right side of the *Tetranodoceras,* which lay uppermost in the limestone, is not preserved, indicating that burial was not completed until some time after the death of the organism, so that the upper parts were subject to decomposition.

Types.—Holotype: New York State Museum, no. 12226/1. Paratypes: New York State Museum, no. 12226/2-3. Hypotypes: Pal. Res. Inst., no. 5365-5366.

Occurrence.—In the Cherry Valley limestone from Union Springs to Schoharie.

CASTEROCERAS Flower, gen. nov.

Genotype: *Cyrtoceras alternatum* Hall

Slender cyrtoconic conchs with a very slight curvature which is greater adapically than adaperturally. Section slightly depressed, the exterior divided distinctly into ten distinct faces in the genotype, though the number may vary. The internal mold preserves the ventral face, but the preservation of the other faces will vary within the species. The sutures are slightly but definitely curved, with a narrow dorsal saddle and a broader ventral saddle separated by lateral lobes. The speta are uniformly and very slightly curved. The siphuncle is close to the ventral wall, and is small and orthochoanitic.

Test thick, bearing irregular transverse undulating liræ which are crossed by a few longitudinal liræ which are coarse, large and rather poorly defined. There are ten of these liræ in the genotype. At intervals of about every other camera the interior bears a ring of nodose expansions, one under each of the liræ. Above these the liræ are projected into short spines. The aperture bears a shallow hyponomic sinus. Gerontically, the interior ceases to develop nodes. It is not known whether the nodes are absent from the exterior, but it seems probable that the change is due to a gerontic thickening of the shell.

In *Thoracoceras* the longitudinal liræ are numerous and prominent, and are armed with many minute spines. In *Casteroceras* the liræ are few, the spines large and rare, and there are many transverse markings which could hardly be found on a member of *Thoracoceras.* The relationship of *Casteroceras* is not clear, but it seems that in view of the presence of spines, a ventral siphuncle, and the transverse undulate ornamentation, this is more closely allied to the Rhyticeratidæ than to any other family.

Congeneric are two species from Canada, one from the Silurian and one from the base of the upper Devonian, and one middle Devonian species from England. It was upon the similarity of his specimen with *Thoracoceras tyrelli* Whiteaves[45] which is a good *Casteroceras,* that Clarke based his generic determination.

This genus is named in honor of Dr. K. E. Caster in recognition of his contributions to Devonian Stratigraphy and Paleontology.

Casteroceras alternatum (Hall) Pl. 4, fig. 5; Pl. 5, fig. 2-5

Cyrtoceras undulatum Hall, J., 1876, Illustrations of Devonian Fossils: Cephalopoda, pl. 47, fig. 9-10.
Cyrtoceras alternatum Hall, J., 1879, Paleontology of New York, vol. 5, pt. 2, p. 365-6, pl. 46, fig. 12-13.
Thoracoceras wilsoni Clarke, J. M., 1901, N. Y. State Mus. Bull., 49, p. 126, pl. 8, fig. 1-5.

A very slightly curved cyrtocone of slightly depressed section; the difference in diameters varying between 1 and 2 mm. in the younger stages, and between 2 and 3 mm. in the more mature portion. The following measurements taken from a number of specimens will show this difference.

Transverse Diameter	Dorso-ventral Diameter	Specimens
18 mm.	16.4 mm.	Holotype, Schoharie
22 mm.	21 mm.	Hypotype, Stockbridge
24 mm.	21.6 mm.	Hypotype, Cherry Valley
27.5 mm.	24 mm.	Holotype, Schoharie
32 mm.	30 mm.	Hypotype, Stockbridge
36.5 mm.	34 mm.	Hypotype, Stockbridge

The rate of expansion is gradual, the diameter increasing from 22 and 21 mm. to 25.8 and 24 mm. in a length of 40 mm., and to

---

[45] Whiteaves, J. F. Descriptions of some new or previously unknown species of fossils from the Devonian rocks of Manitoba. Royal Soc .Canada, Transactions, 1890, no. 4, p. 93, pl. 7, fig. 1-4.

28.6 and 26 mm. in the next 40 mm. This rate is constant up to a point just beyond the base of the mature living chamber where the diameters are 36.8 and 34 mm. Beyond this point there is a broad, gentle constriction.

The cameræ are of moderate depth. Except in the gerontic portion, there are four cameræ in a length equal to the adapertural diameter. At the base of the living chamber, where the transverse diameter is 36 mm., the cameræ have contracted so that there are five instead of four in a length equal to that diameter.

The sutures are transverse and slightly sinuate, the sinuosity varying between individuals. There is a narrow dorsal saddle and a broader ventral saddle which are separated by lobes that are dorso-lateral in position.

The siphuncle is located near the center of the ventral face, which is often poorly defined, and is separated from the ventral wall of the conch by scarcely its own width. Where the conch has a transverse diameter of 19 mm., the siphuncle is 1 mm. in diameter. At this point the cameræ are 5 mm. in depth. The septal neck extends about one-tenth of the distance to the adapical septum, the remainder of the space being occupied by the tubular connecting ring. The siphuncle is orthochoanitic and empty.

The exterior of the shell bears transverse undulate ridges each of which is made up of three or four rows of parallel liræ. These are separated by intervals in which there are very fine transverse liræ. The transverse markings are modified by ten coarse external ridges which are longitudinal. At rhythmic intervals circles of spines are produced. The character of the spines is somewhat variable. One spine, near the base of the living chamber where the diameter is 36 mm., is 7 mm. in length. The production of these spinous processes is reflected upon the internal mold as a recurrent region of expansion. Some specimens show that this consists of a circle of ten low nodes, others show a general expansion with the nodes being low and not well defined. The rather variable thickness of the test determines the effect which the external markings will have upon the interior of the shell. Besides the circles of nodes, there are often faces separated by ten longitudinal ridges of variable clarity. Only one specimen is known in which all ten ridges are clearly defined and the faces are distinct. In such specimens the nodes of the interior are very obscure. As the shell thickens, the faces become more convex and the angles tend to smooth out, leaving only the nodes which lie beneath the spines. Further thickening results in the increasing obscurity of the nodes, until all of one circle of nodes merge into a general annular expansion.

The living chamber is short. Where the diameters at the base are 36.5 and 34 mm., the living chamber is 45 mm. in length. The middle portion bears an elongate gentle constriction, which represents an internal gerontic thickening of the shell, and a complete internal loss of any vestige of the ornamentation of the exterior. The aperture is transverse, but bears a shallow hyponomic sinus. At each of the ten nodes the aperture bears a small, narrow, rounded sinus. The better preserved molds of the living chamber show faint longitudinal markings, and also an irregular transverse line which marks the posterior margin of a depression. The nature of this is unkonwn, but it is possible that it might have to do with scars or the attachment of the mantle.

Discussion.—This species was described by Hall[46] as *Cyrtoceras undulatum,* but as Vanuxem[47] had previously described a species from the Onondaga under that name, Hall changed the specific name to *annulatum.* Hall's description was based upon an immature internal mold in which the nodes were distinct but the faces were obscure. In 1901 Clarke described as *Thoracoceras wilsoni* a specimen from Onondaga Valley, which shows the most perfect internal faces known for the species. At the same time that Clarke obtained the type of *T. wilsoni* be obtained a number of other specimens, which he considered conspecific. These together with the specimens in the Paleontological Research Institution constitute a good series showing graduations between the two type specimens. These agree so closely in rate of expansion depth of the cameræ, the sinuosity of the sutures, and the position and structure of the siphuncle, that we are unable to consider these forms as specifically distinct, but only as extremes of variation within a species.

---

[46] See synonomy above.

[47] Vanuxem, L. Geol. Surv. of New York, rep. of the 3rd dist. p. 139-140, fig. 2. 1842.

It is quite obvious that this species is not congeneric with *Thoracoceras vestitum* Fischer de Waldheim,[48] the genotype of *Thoracoceras.*

Congeneric are *Casteroceras tyrelli* (Whiteaves) from the *Stringocephalus* horizon of Manitoba, and *Casteroceras erro* (McLearn)[49] from the Stonehouse formation of Arisaig, Nova Scotia. This formation was correlated with the Helderberg group by Twenhofel,[50] but McLearn[51] places it as the equivalent of the Guelph and Salina of New York. *Orthoceratites nodulosus*[52] of the Middle Devonian of Germany may also be congeneric if the original description is correct in stating that the siphuncle is marginal, and not central as was stated by D'Archaic and Verneuil[53].

Types.—Holotype, New York State Mus., no. 12101/1. Hypotypes, New York State Mus., no. 12520/1-2. Cornell Univ. Mus., one specimen, (uncatalogued) Pal. Res. Inst., no. 5363-5364.

Occurrence.—In the Cherry Valley Limestone at Schoharie, Cherry Valley, Stockbridge and near Manlius.

RHADINOCERATIDAE Hyatt 1900

This family includes coiled rapidly expanding conchs in which the section of the whorl is transversely oval to kidney shaped. The venter is always more rounded than the dorsum, which may be slightly convex, straight, or may bear a slight impressed zone. The surface of the shell is without nodes or spines, and the ornamentation consists of various combinations of transverse and longitudinal liræ, of which the latter are often sufficiently strong to be represented upon the interior of the shell. Three species are known which occur in the Cherry Valley limestone. One of these, *Nephriticeras bucinum* is redescribed below. The other two, *Lyrioceras liratum* (Hall) and *Lyrioceras dubium* Miller, are only mentioned, for both of these are as yet incompletely known. For the sake of completeness and for the benefit of those who may have occasion to use this paper in determining specimens we give the following summary of the Cherry Valley Nephriticeratidae:

---

[48] Fischer de Waldheim, G. **Thoracoceras (antea Melia)** genre de la famille des Orthoceratites. Bulletin de la Societe Imperiale des Naturalistes de Moscou, vol. 17, p. 655, 1844.

[49] McLearn, F. H. Paleontology of the Silurian rocks of Arisaig, Nova Scotia. Canada Dept. of Mines, Geol. Surv., Mem., 107, geol. ser., no. 118, p. 159, pl. 25, fig. 5-6. 1924

[50] Twenhofel, W. H., Amer. Jour. Sci., ser. 4, vol. 28, p. 143-169. 1909.

[51] Ibid., p. 26.

[52] Schlotheim, Merkwurdige aus der Petrafactensamlung des verstorbenen wirklischen Geh. Raths. Hertz, pl. 11, fig. 2. 1832.

[53] D'Archiac and Verneuil, Trans. Geol. Soc. London, ser. 2, vol. 6. pt. 2, p. 347, pl. 31, fig. 4, 4a. 1842.

I Dorsum with an impressed zone; surface with transverse and longitudinal markings, of which neither are carried through the shell so as to appear on the internal mold: *Nephriticeras bucinum*.

II Dorsum slightly convex, without an impressed zone. The internal mold bears prominent longitudinal ribs: *Lyrioceras*.

1. Liræ strong, rounded and distant from each other by more than their own width; early stage not known: *L. liratum* (Hall).
2. Liræ acute or subacute, not broadly rounded, with concave interspaces, much more numerous than in *L. liratum*. This species is known only from a fragment of an early stage: *Lyrioceras dubium* Miller[54].

NEPHRITICERAS Hyatt

Genotype: *Nautilus bucinum* Hall

Hyatt, A., 1883, Proc. Boston Soc. Nat. Hist., vol. 22, p. 300.
Hyatt, A., 1900, Zittel-Eastmann Textbook of Paleontology vol. 1, p. 523.
Grabau, A. W., and Shimer, H. W., 1910, North American Index Fossils, vol. 2, p. 84.
Foerste, A. F., 1927 Univ. of Michigan Mus. of Geology, Contrib., vol. 2, p. 191.

Rapidly expanding tarphyceracones of usually about two volutions, which are in contact in the ephebic portion, but in which the gerontic portion of the last whorl is free. The section is transversely elliptical, with the venter rounded, the dorsum transverse, the middle portion faintly emarginate. The greatest transverse diameter is located closer to the dorsum than to the venter. The siphuncle is slightly dorsad of the center. Its structure in the genotype is unknown, but in *Nephriticeras magister* (Hall)

---

[54] A new name for **Lyrioceras liratum** (Hall). 1861.

the septal necks are recurved and the segments expand within the cameræ to about twice their diameter at the septal necks. The septal necks are more strongly recurved dorsally than ventrally, and the connecting ring is adnate to the preceding septum only on the ventral side. The siphuncle is without deposits.

Sutures transverse and, according to Hyatt, with a ventral and a dorsal saddle in the young. These are later replaced by broad shallow lobes. The sutures of the genotype appear to be directly transverse except for the dorsal lobe which is characteristic only of the ephebic stage. It is quite possible that Hyatt had in mind some other species when he inserted that character into the generic description, quite possibly *Nautilus cornulum* which was later made the genotype of *Rhadinoceras* Hyatt.

Nephriticeras bucinum (Hall) Pl. 9, fig. 1-2.

Gyroceras expansum ? var., Hall, J., 1860, 13th Rep. New York State Cab. Nat. Hist., p. 104.

Nautilus bucinum Hall, J., 1876, Illustrations of Devonian Fossils: Cephalopoda, pl. 60, fig. 1-4.

Nautilus bucinum Hall, J., 1879, Paleontology of New York, vol. 5, pt. 2, p. 412-14, pl. 40, fig. 1-4; pl. 106, fig. 4-7; pl. 107, fig. 2-5; pl. 109, fig. 1-2.

Nephriticeras bucinum Hyatt, A., 1883, Proc. Boston Soc. Nat. Hist., vol. 22, p. 300.

Nephriticeras bucinum Grabau, A. W., and Shimer, H. W., 1910, North American Index Fossils, vol. 2, p. 84.

Rapidly expanding tarphyceracones of usually about two volutions in the adult condition. These are in contact, and in the ephebic portion there is a very slight impressed zone. The section is transverse, the dorso-ventral diameter being about two-thirds the transverse diameter. Where the transverse diameter is 26 mm., the dorso-ventral diameter is 17 mm. At this stage the point of greatest transverse diameter is located slightly dorsad of the center, and the middle portion of the dorsal outline is faintly excavate, forming an impressed zone. The rate of expansion is great; the dorso-ventral diameter is doubled in half a volution. The conch increases in half a volution from a dorso-ventral diameter of 12 mm. to one of 25 mm. The length of this portion measured along the venter is about 70 mm.

The sutures are transverse. Hyatt's description of the characteristic suture pattern for the genus appears to have been based upon some other species, as has been already pointed out. The sutures of *N. bucinum* appear to be transverse throughout their course along the ventral and lateral surfaces. The dorsum is occupied by a broad shallaw lobe which is more prominent along the middle. This is the natural result of the formation of an impressed zone.

The cameræ are shallow. In a length measured along the ventral outline equal to an adapertural dorso-ventral diameter of 20 mm. there are four cameræ. In a length equal to an adapertural dorso-ventral diameter of 25 mm., there are six and a half cameræ.

The surface of the internal mold is smooth. The shell is of moderate thickness, and bears on its surface a characteristic cancellate ornamentation. There are obscure lines of growth and more distant coarser transverse liræ. These are crossed by rather stronger rounded longitudinal liræ which appear to be more prominent on the dorso-lateral regions than elsewhere, and are absent along the mid-dorsal region where the whorls are in contact. There are about four longitudinal liræ in a width of 10 mm.

The living chamber is short. Where the dorso-ventral diameter at the base is 25 mm., the living chamber, measured along the mid-ventral region, is 45 mm. in length. The aperture bears a very broad and shallow hyponomic sinus and very shallow lateral sinuses, the dorsal and ventro-lateral regions being formed by low crests.

Discussion.—Hall originally described the holotype of this species as *Gyroceras expansum ?* Saemann, but pointed out that the specimen differed from Saemann's description and figure in a number of characters. If Saemann's figure is drawn accurately, his specimen represents a species which is distinct from any of those which Hall described, and until the type can be re-examined it seems best to regard it as distinct from *Nephriticeras bucinum* (Hall).

N. bucinum has a considerable vertical range, for it appears in the Cherry Valley limestone and ranges upward through the greater part of the Hamilton.

Types.—The holotype is the only specimen known from the Cherry Valley limestone. New York State Museum, no. 12321/1.

Occurrence.—Holotype, from the Cherry Valley limestone at Manlius. Other specimens figured by Hall are from various parts of the Hamilton above the Cherry Valley member. The species seems to be most abundant in the longitude of Cazenovia.

CENTROCERATIDAE Hyatt, 1900

This family was erected for the reception of two genera, and was intended to include gyroceracones, tarphyceracones and nautilicones of tetragonal section in which the sutures bore broad lateral saddles. *Centroceras* Hyatt, the type genus, is tarphyceraconic in the adult, and the dorsum is broader than the venter. It is known only from the Middle Devonian. Hyatt also placed in this family *Tetragonoceras* Whiteaves, which is gyroceraconic, has the dorsum narrower than the venter and was described from a species of the *Stringocephalus* horizon of Manitoba. This appears to be more closely related to *Diadiploceras* Hyatt than to *Centroceras*. Incidentally, it migh tbe pointed out that *Diadiploceras* was established upon a genotype which had not been described at the time of the publication of Hyatt's description of the genus, and appears never to have gotten into print. This was *Nautilus quadratus*, a species which Hyatt[55] stated was to be described shortly by Professor Hall. However Hyatt did mention that *Nautilus inoptinatus* belonged in that genus and might as easily serve as a type if the sutures and siphuncle should prove to be similar. We therefore designate that species as the genotype, inasmuch as the genus appears to be a legitimate one, and the designated genotype has not been described. This is therefore the only described species of the genus.

Homaloceras Whiteaves appears to belong here. This is a loosely coiled gyroceracone, or possibly a cyrtoceracone, of quadrangular section, in which the characteristic lateral lobes are present, and in which the venter is narrower than the dorsum. Hyatt placed this genus in the *Ophidioceratidae* on the basis of the arrangement of crests and sinuses at the aperture. Hyatt had followed Barrande in incorrectly calling the type genus of this family *Ophidioceras*. As was pointed out by Miller,[56] further confusion was brought about through the designation of an Ordovician genotype for this group which consisted for the most part of Silurian species. Miller in the same paper described the genus *Euophioceras* for the Silurian forms, with *O. simplex* Barrande as the genotype. *Ophioceras* is circular in section and *Euophioceras* is subtriangular, with all angles well rounded. We can see no relationship between *Homaloceras* with either of these genera, and therefore remove it to the Centroceratidae. It agrees with *Centroceras* more closely than does *Tetragonoceras.*

---

[55] Hyatt, A., Proc. Boston Soc. Nat. Hist. vol. 22, p. 268. 1883.

[56] Miller, A. K. The Myxochoatnitic Cephalopods. Univ. of Iowa Studies; Studies in Natural History, vol. 14, no. 4, p. 15-19, pl. 2, fig. 1-7. 1932.

CENTROCERAS Hyatt

Genotype: **Goniatites marcellensis** Vanuxem

Hyatt, A. 1883, Proc. Boston Soc. Nat. Hist., vol. 22, p. 283-4.
Hyatt, A. 1900, Cephalopoda, in Zittel-Eastmann Textbook of Paleontology, 1st. ed., vol. 1, p. 525.
Grabau, A. W., and Shimer, H. W., 1910, North American Index Fossils, vol. 2, p. 93.

Conch tarphyceraconic, consisting of a few rather rapidly expanding volutions. Umbilicus perforate and wide, the early portion gyroconic. The whorls are in contact over the greater portion of this form, and there is a very slight impressed condition near the base of the mature living chamber. The mature whorl is tetragonal in section, being divided into four faces by sharp umbilical and abdominal angles. The dorsum is broad, convex in the young, nearly straight in the mature portion. The lateral faces are oblique, approaching each other ventrad. The ventral face is narrow and scarcely convex. The whorl is compressed; the height being to the diameter across the umbilical angles as three is to two. The diameter across the abdominal angles is about half that of the umbilical angles.

The sutures bear broad lateral lobes with subacute saddles on the umbilical and abdominal angles. The ventral face bears a shallow lobe. The dorsal portion is nearly transverse but a broad shallow lobe can be distinguished in the mature portion.

The siphuncle is tubular, and is separated from the ventral wall by more than its own diameter. The living chamber occupies about half a volution. Its length measured along the abdominal angles is about twice the vertical diameter at the base.

The ornamentation consists of alternating striæ and liræ which are more or less fasciculate. The lines slope slightly adapically from the umbilical and abdominal angles to a low subangular lateral sinus. The ventral face bears a well defined rounded sinus. In the genotype the abdominal angles bear a series of short spines which appear as small nodes upon the interior in the ephebic stage. In the younger portion the nodes are confined to the exterior.

Centroceras marcellense (Vanuxem) Pl. 7, fig. 4; Pl. 8, fig. 6.

Goniatites Marcellensis Vanuxem, L., 1842, Geology of New York, vol. 3, Rep. of the Third District, p. 146, fig. 2; p. 143.
Discites ornatus Hall, J., 1860, 13th Rep. New York State Cab. Nat. Hist., p. 103, fig. 21-22.
Nautilus ornatus Hall, J., 1861, 14th Rep. New York State Cab. Nat. Hist., p. 24-5, pl. 11a, fig. 5-6.
Nautilus (*Discites*) *Marcellensis* Hall, J., 1876, Illustrations of Devonian Fossils; Cephalopoda, pl. 65, fig. 1-2.
Nautilus (*Discites*) *Marcellensis* Hall, J., 1879, Paleontology of New York, vol. 5, pt. 2, p. 428-30, pl. 65, fig. 1-2; pl. 109, fig. 9-12.
Nautilus (*Discites*) *Marcellensis* Hall, J., 1888, Paleontology of New York, vol. 5, pt. 2, supplement, (in vol. 7,) p. 38, pl. 125, fig. 1.
Centroceras (*Discites*) *Marcellense* Hyatt, A., 1883, Proc., Boston Soc. Nat. Hist., vol. 22, p. 284.
Centroceras marcellense Grabau, A. W., and Shimer, H. W., 1910, North American Index Fossils, vol. 2, p. 93, fig. 1316.

A rapidly expanding tarphyceracone of fewer than three complete volutions, the whorls in contact, but with only an incipient impressed zone which is visible on the base of the living chamber and the two adapertural cameræ in the mature conch. The whorl is tetragonal in section, with sharp umbilical and abdominal angles. At the base of the living chamber the lateral face is 42 mm., the diameter across the umbilical angles is 36 mm. and the diameter across the abdominal angles is 18 mm. At the middle of the living chamber, where an arc of about 70 degrees is described from the base of the living chamber, the lateral face is 49 mm., the umbilical diameter is 40 mm., and the abdominal diameter is 24 mm. The rate of dorso-ventral expansion is considerable, increasing from 14 to 28 mm. in half of a volution, and in an earlier part, from 5 to 14 mm. in half a volution.

The sutures bear a broad rounded dorsal lobe, sharp umbilical saddles, broad lateral lobes, abdominal saddles which are again angulate, and ventral lobes, which occupy the greater part of the ventral face but not all of it, the sutures at the lateral portion being nearly transverse. Where the lateral lobe is 24 mm. in width, it is 6 mm. in depth. On the same suture the ventral face is 8 mm. wide and the lobe is 3 mm. deep. The cameræ vary only slightly in depth. In the length of the phragmocone which describes one and one-quarter volutions the depth of the cameræ as measured along the venter varies from 3 mm. to 5 mm. Where the dorso-ventral diameter is 12 mm., there are four and a half cameræ in an equal length measured along the venter. Where the diameter is 24 mm., there are eight cameræ in a similar length. Where the diameter is 36 mm., there are eleven camræ in a similar length.

The siphuncle is tubular, and is 2 mm. in diameter at a point where the dorso-ventral diameter of the whorl is 24 mm., and it is located 3.5 mm. from the ventral wall.

The living chamber measures 104 mm. along the venter from the base to the aperture. Its dorso-ventral diameter at the base is 36 mm. The ventral part of the mature aperture is preserved, as is shown by the sudden contraction.

The surface is ornamented by a series of small spinous processes on the umbilical angles. In the ephebic part of the conch the shell is thin and these can be seen on the interior as well as upon the exterior, but they gradually disappear internally, so that there is no trace of them upon the internal mold of the gerontic living chamber, though they are as well developed as ever externally.

In the early part of the conch both transverse and longitudinal liræ are present, but the longitudinal liræ become vestigial in the last half volution. The transverse markings persist as alternating rounded liræ and striæ, and are more or less fasciculate, with about every fourth one of the liræ strengthened. The markings slope adapically from the umbilical shoulder and the abdominal angles with a slight curve the convex side of which is directed adaperturally to a mid-internal sinus which is occupied by a conspicuous ridge in the young. (pl. 8, fig. 6.) The ventral face is occupied by a clearly defined hyponomic sinus, which fills the greater part of the surface.

Discussion.—This is a very distinctive species, which is found in the Cherry Valley limestone. There has arisen considerable confusion as to the identity and abundance of this form. Vanuxem figured this species and named it *Goniatites marcellensis*, but in his description he confused it with the large goniatites which he described as *Goniatites expansus.* Vanuxem's figure is recognizable, however, even though his type has been lost. As pointed out by Hall[57], Vanuxem's statement concerning the abundance of this species is erroneous and is due again to the confusion with the large goniatites.

Types.—New York State Museum no. 12327/1 is catalogued as Vanuxem's type. As Hall apparently never had any of Vanuxem's specimens it seems probable that this is an error. This specimen appears to be the type of Hall's figure in the 13th Report of the New York State Cabinet of Natural History. It may be regarded as a hypotype. Other hypotypes are: N. Y. S. Mus., no 12327/4. Plesiotype: Pal. Res. Inst., no. 5371. The holotype is probably lost.

Occurrence.—In the Cherry Valley limestone at Union Springs, Manlius, Stockbridge, Schoharie and from the Berne member at Camp Pinnacle in the Berne quadrangle.

Suborder CYRTOCHOANITES Hyatt 1900

PALMEROCERAS Flower, gen.

Genotype: Orthoceras fustis Hall

Slender orthoceracones circular in section, with straight transverse sutures and evenly curved septa. The siphuncle is central in position and is definitely cyrtochoanitic. The septal necks are very short and strongly recurved, so that the brims are about twice the necks. The connecting rings are straight to the preceding septum to which they are adnate for a short distance. The siphuncle at its widest is three-fifths its length, and at the septal necks contracts to about half the diameter at the connecting rings. The aperture is sinuous, bearing three shallow sinuses, and is very slightly contracted gerontically. Preceding the contraction, which is external as well as internal, there is a series of internal contractions due to a thickening of the shell. The early ones are slight, but the last is very prominent. The surface is ornamented with transverse rather irregular liræ which are finely and regularly frilled, giving the surface the appearance of possessing cancellate ornamentation.

---

[57] Hall, James. Paleontology of New York, vol. 5, pt, 2, text, p. 430, footnote. 1879.

This genus is named in honor of Dr. K. V. W. Palmer.

Palmeroceras fustis (Hall) Pl. 2, fig. 4; Pl. 4, fig. 1-2; Pl. 7, fig. 3.

Hall, James. 1879. Paleontology of New York, vol. 5, pt. 2, p. 281, pl. 83, fig. 11, pl. 113, fig. 16-17.

Shell orthoceraconic, enlarging regularly to a point near the aperture. The section is circular. In a length of 36 mm., the conch enlarges from a diameter of 27 mm. to one of 36 mm. The sutures are straight and horizontal. The convexity of the septum is slight, the depth being one-fifth the diameter of the conch. The siphuncle is central and small. The diameter is 3.5 mm. where the diameter of the conch is 35 mm. The siphuncle in section is cyrtochoanitic. The septal necks are very short and are strongly recurved, so that the neck is one-half the length of the brim. At the passage through the septa the interior of the siphuncle is 1.4 mm. in diameter. The connecting rings are subcylindrical, expanding very slightly toward the middle. At the preceding septum the rings turn sharply in and are with a definite area of adnation. No internal deposits are known either within the siphuncle or within the cameræ.

Shell strong and thick, with internal annular thickenings on the living chamber which increase in prominence up to the last which is 14 mm. in length and terminates 15 mm. from the aperture. The last 7 mm. of the aperture show a decided contraction of the shell. The aperture itself is sinuous, showing three shallow sinuses.

The surface is ornamented by fine transverse liræ which vary somewhat in prominence and are arranged in transverse bands between which there are frequent distinct breaks. Within each of these bands of liræ, each of the liræ is finely and regularly festooned, with small excrescences at the angles of the festooning which give to the shell the appearance of cancellate ornamentation described and figured by Hall[58].

---

[58] Hall, James. Paleontology of N. Y., vol. 5, pt. 2, p. 281-282, pl. 83, fig. 11. 1879.

The living chamber is slightly less than twice the diameter at the last septum. The length is 60 mm. where the diameter at the base is 35 mm.

Remarks.—This species is known from only a single specimen, Hall's type. It is obviously cyrtochoanitic, but its affinities within the Cyrtochoanites are somewhat doubtful in the absence of any trace of internal deposits. It is referred somewhat tentatively to the Pseudorthoceratidæ of the Annulosiphonata.

Type.—The only specimen known, the holotype by monotypy is in the New York State Museum, No. 12371/1.

Occurrence.—In the Cherry Valley limestone at Schoharie.

THE BREVICONES

Hall described, in the Paleontology of New York, which may be taken to represent his final views on the subject, four species of brevicones, all of which he included in the genus *Gomphoceras.* From the study of Hall's types and some additional specimens it now appears that there are more species than these four, and that each of Hall's species represents a different genus within which it is possible to differentiate several Cherry Valley species.

A word might be said about the classification. Foerste[59] recently divided the actinoceroid cephalopods into a number of groups which might be given the rank of families were it not that there is reason to doubt whether these groups are natural. Foerste appears to have been of this opinion, for he proposed no names for these groups.

The characters upon which the genera of brevicones are based are those connected with gerontic specimens, and which cannot be applied to immature or nearly grown specimens without much caution. Particularly difficult is the relation of the point of greatest dorso-ventral diameter to the living chamber, which obviously varies as septa are deposited and the living chamber moves forward: Gerontic specimens may be distinguished by two characters: the contraction of the aperture and the decrease in depth of the adapertural cameræ. Indeed, the impressed zone appears, at least in the specimens we have examined, to represent the slightly modified adapertural camera which is shallow, has the wall of the conch thickened internally at this point, sometimes with a definite type of ornamentation, and in which the last septum is thin and possibly incomplete.

---

[59] Foerste, A. F. Actinosiphonate, trochoceroid and other cephalopods. Denison Univ. Bull. Jour. Sci. Lab., vol. 21, p. 285-384, pl. 32-53. 1926.

Considerable variation in size was found in the specimens of brevicones. In one instance we have ventured to suggest, in *Verticoceras sp.* that this might be a sexual difference, and this form might be a male of *V. erectum.* Such explanations must, however, always be regarded with considerable skepticism, particularly since it is the male which is the more gibbous in *Nautilus pompilius.*

The Cherry Valley brevicones may be briefly summarized as follows:

I. Slender, apex endogastric .... *Verticoceras*
  A. Size small, upper part of phragmocone curved; aperture not abruptly constricted .... *V. conradi*
  B. Size larger, upper part of phragmocone not distinctly curved; aperture abruptly constricted .... *V. erectum*

II. Exogastric, nearly erect, venter convex, and dorsum nearly straight.
  A. Size large, aperture transverse, without hyponomic sinus .... *Poteriocerina solidum*
  B. Size usually smaller, hyponomic sinus present.
  a. Very small, section not distinctly depressed, vertical outline broadly oval, expansion and contraction rapid .... *Ovoceras (?) gibbosum*
  b. Larger; contraction concentrated on outer third of living chamber .... *Ovoceras*
    1. Shell thickened internally before aperture, dorsal margin convex .... *O. constrictum*
    2. Shell not thickened; aperture straight dorsally .... *O. oviforme*
  c. Still larger; aperture largely open, subtriangular; in mature specimens the contraction begins well below the living chamber .... *Acleistoceras fischeri*

ACLEISTOCERAS Hyatt

Genotype: **Apioceras olla** Saemonn

Hyatt, A., 1883, Proc. Boston Soc. Nat. Hist., vol. 22, p. 277.
Hyatt, A., 1900, Zittel-Eastmann Textbook of Paleontology, p. 530.
Foerste, A. F., 1926, Denison Univ. Bull., Jour. Sci. Lab., vol. 21, p. 336, pl. 44, fig. 6.
Foerste, A. F., 1927, Michigan Univ., Mus. of Geol., Contrib., vol. 2, p. 196.

Erect exogastric brevicones of nearly circular, slightly depressed section. The venter is more convex than the dorsum throughout the known part of the genotype, and it is supposed that the apical portion would exhibit a slight exogastric curvature. In mature specimens the point of greatest gibbosity is several cameræ below the living chamber. Adorally, the venter is more convex than the dorsum. The aperture is transverse and subtriangular, with the dorsal margin straight, the lateral lobes narrowly rounded, and the ventro-lateral margins converging to crests which are separated by the hyponomic sinus. The phragmocone is made up of moderately shallow cameræ with transverse sutures. The siphuncle is close to the ventral wall. Its segments are nummuloidal, with convex lateral outlines, but abruptly contracted near the septa and scalariform in vertical section. The siphuncle structure of the genotype is unknown but in closely related forms vertical lamellæ are present.

Acleistoceras fischeri (Hall) Pl. 8, fig. 9-10.

Gomphoceras (*Apioceras*) *Fischeri* Hall, J., 1860, 13th Rep. New York State Cab. Nat. Hist., p. 106.
Gomphoceras Fischeri Hall, J., 1876, Illustrations of Devonian Fossils: Cephalopoda, pl. 45, fig. 5-6.
Gomphoceras Fischeri Hall, J., 1879, Paleontology of New York, vol. 5, p. 336, pl. 45, fig. 5-6.

This is a typical *Acleistoceras* in vertical outline. The section is subcircular, very slightly depressed. The ventral outline is faintly convex below, but curves more strongly over the region of greatest gibbosity which is some distance below the base of the mature living chamber, and continues to curve strongly over the living chamber, so that the contraction is greater on the ventral side than on the dorsal side. The dorsal outline is straight below, only faintly convex over the region of greatest gibbosity, and nearly straight adaperturally.

The holotype expands from a dorso-ventral diameter of about 45 mm. to 79 mm. in about 95 mm. The apical portion is somewhat crushed and poorly preserved. In the next 65 mm. the conch contracts to 60 mm. at a point slightly above the base of the living chamber. The chamber is 62 mm. in length, and the apertural portion is very poorly preserved. The conch appears to contract to a dorso-ventral diameter of about 45 mm. at a position which would lie about 75 mm. beyond the point of greatest gibbosity. The phragmocone is about 110 mm. in length. The sutures are straight and the cameræ vary in depth from 4.5 mm. to 10 mm. The last two cameræ are shallower than the ones directly preceding them, measuring 8 mm. and 4.5 mm. in depth respectively. The siphuncle is described as ventral. It is not visible on the lectotype. The base of the living chamber bears an impressed zone the nature of which is discussed elsewhere.

The living chamber measures 73 mm. in dorso-ventral diameter at the base, and contracts toward the aperture which is 62 mm. beyond. The diameter here is estimated at about 45 mm.

The surface of the shell bears rather coarse transverse liræ and striæ. The interior of the shell leaves longitudinal liræ on the internal mold. These are visible in the apical part of the specimen and reappear on the impressed zone. There are twenty to twenty-two of these in the width of 10 mm. The condition of the aperture is incompletely known. Only 20 mm. of it are preserved. The conch is transverse at this point. Hall describes the aperture as large and oval, with the hyponomic sinus appearing as a gentle bend on the ventral side. This could not have been based upon the lectotype, but from the hypotype it appears that Hall's description was essentially correct.

Hypotype.—Conch erect, breviconic, with a nearly circular section which is, however, slightly depressed in the later portion. The diameter at the base of the phragmocone is 60 mm. This increases to a dorso-ventral diameter of 74 mm. 43 mm. above the base. From this point the diameter decreases to 57.8 mm. at the aperture. The dorsal outline is faintly convex on the outer third of the living chamber, but is straight below. The venter is slightly convex below, and more strongly convex over the region of greatest dorso-ventral diameter. Toward the aperture the curvature decreases slightly.

The sutures are transverse. The normal cameræ vary from 7.5 mm. to 9 mm. in depth in a length of 43 mm., while the last two measure 6.5 mm. and 3.2 mm.

The living chamber is 41 mm. in length, and has a dorso-ventral diameter at the base of 72 mm. The aperture is not greatly contracted, and the position of the shell near it is nearly vertical as in typical *Acleistoceras.* The aperture bears a broad dorsal crest, lateral sinuses and ventro-lateral crests between which is located the shallow hyponomic sinus.

The surface of the shell bears irregular coarse transverse liræ and striæ which are crossed by finer longitudinal liræ. The internal mold is marked by numerous equal longitudinal liræ which are about four to six in a width of 5 mm.

Discussion.—Though it has not been possible to examine the holotype of this species it appears that Hall's figure is incorrect in its restoration of the ventral part of the aperture. The hypotype differs from Hall's type in being slightly smaller, in possessing more numerous longitudinal liræ on the internal mold, and in possessing faint longitudinal markings on the surface of the shell. The size can hardly be regarded as a specific difference, and might be due to sexual differentiation or regional variation. The liræ of the exterior and of the interior vary with the preservation. The most important difference is found in the length of the living chamber in proportion to its dorso-ventral diameter at the base. This character might be used to separate the hypotype from *A. fischeri,* but it is not inconsistent with our knowledge of the brevicones to regard this too as a variation which might well occur in the species.

Types.—Lectotype: Amer. Mus. Nat. Hist., no. 4413/1; two specimens are catalogued under this number; the lectotype is the type of Hall's pl. 45, fig. 5. The type of pl. 45, fig. 6 is a paratype. Hypotype: New York State Museum, no 1200d/1.

Occurrence.—In the Cherry Valley limestone at Manlius.

OVOCERAS Flower, gen. nov

Genotype: **Gomphoceras oviforme Hall**

This is a depressed erect brevicone with apparent exogastric affinities. The conch expands gradually to a point well above the base of the mature living chamber, usually at least to a point above the middle. The ventral outline is convex, the dorsal outline nearly straight in the known portion of the phragmocone. It is believed that the apical portion might have a slight exogastric curvature which is not present in the more mature portion. Beyond the point of greatest dorso-ventral diameter, which coincides with the point of greatest transverse diameter, the rate of contraction is abrupt, and the shell curves rapidly over the aperture so that its plane becomes more nearly transverse than vertical. The aperture is subtriangular, but in the known species the lateral and hyponomic sinuses are more rounded than in *Acleistoceras.*

The sutures are transverse and the siphuncle is located near to the ventral wall of the conch. Its structure is unknown, and may or may not resemble the structure of the closely allied *Acleistoceras.*

Discussion.—This genus differs markedly in appearance from its closest relative *Acleistoceras,* its most prominent feature being the late appearance of contraction, the marked curvature of the shell over the oral surface, and the condition of the contraction on the dorsum of *Ovoceras,* which is as great as that of the venter or greater.

Ovoceras oviforme (Hall) Pl. 8, fig. 1-2.

Gomphoceras (*Apioceras*) *oviforme* Hall, J., 1860, 13th Rep. New York State Cab. Nat. Hist., p. 105.
Gomphoceras oviforme Hall, J., 1876, Illustrations of Devonian Fossils: Cephalopoda, pl. 45, fig. 1-2.
Gomphoceras oviforme, Hall, J., 1879. Pal. New York, vol. 5, pt. 2, p. 344-6, pl. 45, fig. 1-4; not pl. 94, fig. 6-7, pl. 46, fig. 6-7.
Poterioceras oviforme Grahan, A. W., and Shimer, H. W., 1910, North American Index Fossils, vol. 2, p. 129, fig. 1376.

A moderate size brevicone, of which the living chamber and the adoral cameræ, the only part known of this species, appear erect. The dorsum is straight below, with a faint suggestion of concavity, and the venter is only very slightly convex. This condition continues to the point of greatest gibbosity, which is located two-thirds of the distance from the base of the mature living chamber to the aperture. At this point there is a sudden increase in the convexity of the venter, and the dorsum becomes markedly convex, so that it appears, from the living chamber alone, more curved than the venter.

The sutures are transverse. The cameræ are moderate in depth, contracting gerontically. The cameræ of the lectotype, of which there are four, measure in depth 5 mm., 5 mm., 4 mm., and

3 mm., beginning adapically. The septa are shallow, being about 3 mm. in depth where the diameter is 28 mm. The siphuncle is located close to the ventral wall of the conch from which it is separated by about twice its diameter. Its structure is unknown.

The living chamber has diameters of 33 and 38 mm. at the point of greatest gibbosity, which is located about 16 mm. above the last septum. The aperture is 27 mm. beyond the base of the living chamber, dorsally, though this is somewhat less ventrally on account of the hyponomic sinus.

The aperture is transverse and straight dorsally, broadly rounded laterally, the ventro-lateral portion oblique, sloping down until interrupted by the hyponomic sinus, which is slightly less than one-fourth the greatest diameter of the aperture. The sinus is rounded, its depth 3 mm., where it is 7 mm. across. The transverse diameter of the aperture is 29 mm, and the dorso-ventral diameter through the hyponomic sinus 22 mm., in the lectotype.

The shell is nearly 2 mm. in thickness over the point of greatest gibbosity of the living chamber. There is no gerontic variation in thickness. The surface of the shell is marked by transverse lines of growth, which are rather obscure in the lectotype.

Discussion.—This species is characterized by the dorsally transverse aperture, the uniform thickness of the shell adaperturally, and the well rounded hyponomic sinus. Hall described as conspecific with this two other forms, which are described below.

Types.—Lectotype, New York State Museum, no. 12194/1. Paratype, Amer. Mus. Nat. Hist., no. 4414/1.

Occurrence.—In the Cherry Valley limestone at Schoharie and Manlius.

Ovoceras constrictum (Hall) Pl. 8, fig. 4-5.

Gomphoceras oviforme Hall, J., (in part) 1879, Paleontology of New York, vol. 5, pt. 2, p. 344-46, pl. 94, fig. 6-7. Not pl. 45, fig. 1-4, nor pl. 46, fig 6-7.

This is an erect or nearly erect species, the apex of which exhibits only a slight exogastric curvature, so that the venter is convex but the dorsum is scarcely concave. The section is depressed. The known portion of the phragmocone expands from diameters of 17 mm. dorsoventrally and 17.5 mm. transversely to 28 mm. and 30 mm. respectively in a length of 97 mm.

Mature living chambers vary slightly in size. The vertical and transverse outlines are faintly convex over the lower two-thirds of the living chamber, almost parallel. On the outer third there is an abrupt contraction, which is in part due to the curvature of the shell over the oral surface, and which is in part due to a gerontic internal thickening of the shell on the region directly before the mature (gerontic) aperture. The aperture differs from that of *Ovoceras oviforme* in that the dorsal margin is distinctly curved and is without the prominent dorsal crest.

The holotype is slightly obliquely distorted, so that the right side apparently contracts, but the other side is oblique and parallel. (pl. 8, fig. 4.) The diameters at the base of the living chamber are 25 mm. and 27 mm., the transverse diameter being the greater.

The living chamber is 20 mm. in length on this specimen and the greatest diameters are 26 mm. and 28 mm. These diameters occur at about the middle. The lateral and dorso-ventral outlines are so faintly convex that the point of greatest gibbosity cannot be located accurately. At a point 15 mm. beyond the aperture the diameters are 24 mm. and 26 mm. Beyond this the internal mold exhibits a sharply contracted transverse groove which is the impression of the internal thickening of the shell which is characteristic of the species. At the aperture the dorso-ventral diameter is 15 mm., and the transverse diameter is 20 mm. The dorsal margin is evenly convex, the lateral lobes are rounded, the ventro-lateral crests are subangular, and the margin of the aperture dorsad of them is nearly transverse. The hyponomic sinus is subquadrangular, and is 4.5 mm. in depth and 6 mm. across.

The sutures are transverse, and the cameræ are shallow, The holotype bears a vestige of the weak, last-formed septum of the impressed zone. The last camera is scarcely 1 mm. in depth. The convexity of the septum is 4 mm. where the diameters are 25 mm. and 27 mm. The siphuncle is not shown on the holotype, but is known from a slightly compressed specimen the section of which is so distorted as to be circular. The diameter here is 30 mm, the siphuncle is 1.5 mm. in diameter and is located 4 mm. from the ventral wall.

The surface of the shell bears transverse lines of growth which are fine and inconspicuous.

Discussion.—This species is characterized by the internal thickening of the shell near the aperture and the curved dorsal margin of the aperture. Both characters serve to separate this species from *Ovoceras oviforme.* The contraction of the last cameræ and the internal thickening indicate that this is a mature specimen. It is slightly smaller that *O.oviforme,* and without these criteria might be looked upon as an immature specimen of that species, for the apertural outline might be paralleled in a representative of that species which had not quite completed its growth.

Four specimens of this species are known to us. One of them, that bearing the greater part of the phragmocone, should perhaps be referred to this species with some doubt. The specimen is of a very slightly smaller size, and the condition of the aperture is not known. Its measurements show this specimen to be too closely similar to *O. constrictum* to merit its separation, and in this respect it is much closer to *O. constrictum* than it is to *O. oviforme.*

Types.—Holotype, New York State Museum, no. 12194/3. Paratypes, New York State Museum, no. 12194/4, no. 12438m/1.

Occurrence.—In the Cherry Valley limestone at Schoharie, Stockbridge and Manlius.

Ovoceras (?) gibbosum (Hall) Pl. 4, fig. 6; pl. 8, fig. 3.

Cyrtoceras gibbosum Hall, 1876, Illustrations of Devonian Fossils: Cephalopoda, pl. 47, fig. 3-4.

Gomphoceras oviforme Hall, (in part,) 1879, Paleontology of New York, vol. 5, pt. 2, p. 344-46, pl. 46, fig. 3-4; (not pl. 45, fig. 1-4, nor pl. 94, fig. 617.)

This little known species is the smallest of the Cherry Valley brevicones. The conch is apparently erect, and is of nearly circular slightly depressed section. Both the ventral and lateral outlines expand evenly to a point just above the base of the living chamber, and contract adaperturally from there. Hall's figure shows a slight reduction in the rate of expansion in the region near the aperture. This is incorrect. The rate increases slightly in that region, as is shown by another specimen. The dorsal outline is unknown.

The section is apparently subcircular below, transverse above; the transverse diameter being to the dorso-ventral diameter as five is to six, as nearly as can be estimated. The phragmocone is known only from the holotype. There are seven cameræ in the length of 20 mm., and these vary from 1.7 to 3 mm. in depth. The sutures are transverse. The siphuncle is small and is separated from the margin by more than its own diameter. The structure is unknown. In the length of 20 mm., the transverse diameter expands from an estimated width of 12 mm., to 28 mm. The known portion of the living chamber is 18 mm. in length. The transverse outline is very nearly straight over the lower third, so that 5 mm. above the base the diameter is 28 mm. This decreases to 20 mm. 18 mm. above the base.

Another specimen shows a portion of the aperture, which is believed to represent the ventral side though this is open to question. There is a slight emargination in one side, which appears to represent the hyponomic sinus. The remainder of the known portion, which in all describes an arc of about 150 degrees, appears to be circular. The dorsal margin is unknown.

The surface of the shell bears transverse striæ or lines of growth which are very fine. The internal mold often bears obscure traces of transverse liræ and longitudinal liræ, causing a cancellate or fenestrate appearance. In the interspaces can sometimes be made out much finer longitudinal markings. This appears to be a structure of the nacreous or prismatic layer of the shell.

Discussion.—This little known species is referred to the genus *Ovoceras* only with grave misgivings. There seems to be no other genus for its reception, and the species is too inadequately known to serve as a genotype. It will suffice to point out that the lack of knowledge concerning the dorsal outline is an obstacle which must be surmounted before the species can be placed accurately. It differs from typical *Ovoceras* in having the conch contracted over the greater portion of the living chamber, and also in the presence of the markings of the inner layers of the shell which are known in a number of brevicones, but not in any species so far referred to *Ovoceras*.

Types.—Holotype, New York State Museum, no. 12194/2. Hypotype, Pal. Res. Inst., no. 5367.

Occurrence.—In the Cherry Valley limestone at Schoharie and Stockbridge.

POTERIOCERINA Foerste

Genotype: **Cyrtoceras lumbosum** Barrande

Foerste, A. F., Denison Univ. Bull., Jour. Sci. Lab., vol. 21, p. 343, pl. 45, fig. 1A-C, 2. 1926.

Apex unknown, probably with a slight exogastric curvature, and with a concave dorsal outline. Venter convex throughout; dorsum faintly concave in the lower part of the phragmocone of the genotype, faintly convex above. In mature specimens the point of greatest gibbosity is about 4 cameræ below the living chamber. The lateral outline expands to the point of greatest gibbosity and contracts evenly adaperturally. The section is transverse throughout, with the dorsum slightly flattened, the venter distinctly rounded. The sutures are transverse, the septa shallow, and the siphuncle is close to the venter, almost in contact with the wall of the conch. In outline the segments of the siphuncle expand slightly within the cameræ. Their greatest width is slightly less than their height, and the diameter at the septum is to the greatest diameter as three is to four. The interior contains actinosiphonate deposits in the genotype.

The aperture is transverse, without any trace of a hyponomic sinus. The thickness of the shell and the ornamentation are unknown.

Discussion.—*Poteriocerina* was described by Foerste as one of a series of depressed exogastric brevicones without hyponomic sinus. Of these genera two, *Conostichoceras* and *Turnoceras,* appear to have uncontracted apertures, though the apertures are not known for the genotypes of either. The third, *Poteriocerina,* is moderately gibbous and possesses a moderately contracted aperture. The last, *Gonatocyrtoceras,* differs markedly from the others in possessing a concave dorsal outline throughout.

Poteriocerina solidum Pl. 9, fig. 8-10.

Gomphoceras solidum Hall, J., 1879, Paleontology of New York, vol. 5, pt. 2, p. 338, pl. 93, fig. 9.

Erect exogastric brevicone of transverse section. The venter is uniformly convex throughout the known length, which includes the living chamber, and ten cameræ. The dorsum is very faintly convex over this portion, straighter below, and is probably apically concave.

Section transverse, with a difference of 9-10 mm. between the transverse and dorso-ventral diameters. At the base of the specimen the diameters are 43 mm. and 52 mm.; in a length of 73 mm. they increase to 67 mm. and 79 mm., at the point of greatest gibbosity. In the remainder of the conch, which is 47 mm. in length, the diameters contract to 47 and 78 mm. at a point near the aperture.

The siphuncle is close to the ventral wall but not in contact with it. Its structure is unknown.

The sutures are transverse. The adapical eight vary from 3.5 mm. to 8 mm. in depth and occupy a length of 59 mm. The next is contracted, and the last is 3.5 mm. in depth.

The margin of the aperture is not preserved, but it appears that it is not contracted and that there is no hyponomic sinus present.

The surface markings and the thickness of the shell are unknown.

Discussion.—Insofar as can be told in the absence of any definite information as to the nature of the siphuncle, this species is a typical *Poteriocerina.* It agrees with the genotype, *Poteriocerina lubosum* (Barrande) in general outline, the condition of the aperture, and the relation of the base of the mature living chamber to the point of greatest gibbosity. It is not sufficiently rapidly expanding to be referred to *Conostichoceras* Foerste, and there is no evidence of the geniculate outline of *Turnoceras* Foerste. Further, both of these genera have inadequately known apertures and it will be difficult to refer species to them with certainty. *Gonatocrytoceras* is a much more curved form with the dorsum concave and is much more gibbous.

The above description is based entirely upon a previously unfigured specimen in the New York State Museum. This differs from the holotype in transverse outline, in the more gradual transition from expansion to contraction at the point of greatest gibbosity, but agrees with it, insofar as can be determined from the very imperfect preservation of the holotype, in section, size and aperture. It seems possible that the difference might again be one of variability, possibly sexual dimorphism within a single species. The holotype is not reproduced here; only one side of the specimen is preserved, and Hall's drawing is accurate in all important particulars. The portion of the shell preserved appears to be ventral, the aperture is not clear, and the specimen appears to be slightly crushed, which might in part account for the difference in the transverse outlines of the two specimens.

Types.—Holotype, New York State Museum. no. 12201/1. Hypotype, New York State Museum, no. 12437/1.

Occurrence.—In the Cherry Valley limestone at Manlius. A fragment of a phragmocone referred with doubt to this species was found at Stockbridge.

VERTICOCERAS Flower, gen. nov.

Genotype: **Verticoceras erectum** Flower, sp. nov.

This genus includes endogastric brevicones with a slightly contracted aperture. The genus may be related to *Alpenoceras* Foerste[60], from which it differs in being much less gibbous, in having the section depressed instead of compressed, and in possessing a straight living chamber. The genotype was selected as representing a more extreme condition than *Verticoceras conradi* (Hall), which possesses a slightly curved phragmocone. The upper part of the phragmocone of *V. erectum* shows no trace of curvature.

The transverse section is slightly compressed, nearly circular. The sutures are transverse and straight. The siphuncle is close to the ventral wall, almost if not in contact with it. The structure is unknown. The aperture is rounded, not transverse, and bears a well rounded hyponomic sinus, larger in proportion to the aperture than the more angular sinus of *Alpenoceras*. The surface of the shell bears only transverse lines of growth.

Verticoceras erectum, Flower, sp. nov. Pl. 9, fig. 6-7.

Gomphoceras conradi Hall, J., (in part) 1879, Pal. of New York, vol. 5, pt. 2, ,pl. 46, fig. 3, (not fig. 1-2.)

Only the mature living chamber and four of the adapertural cameræ are known of this species. Conch apparently erect, with a slightly depressed section. The dorsal outline is faintly convex below, straight from the middle of the aperture to a point near the aperture, where abrupt contraction occurs. The venter is strongly convex over the middle portion of the living chamber, but is much less convex below. Adaperturally the ventral outline is contracted in a manner similar to that of the dorsal outline. Although the shell evidently grew over the aperture so that much of the surface would be visible in an oral view, part of the contraction here is due to an internal thickening. There is reason to believe that the apical portion of this conch is slightly curved endogastrically.

---

[60] Foerste, A. F. Devonian Cephalopods from Alpena in Michigan. Univ. Michigan, Mus. of Geol. Contrib., vol. 2, p. 205, 1927.

The sutures are transverse and the cameræ are shallow. The portion of the phragmocone known measures 17.5 mm. in length on the dorsal side. This contains 8 cameræ. The siphuncle appears to be small, close to the ventral wall, but not in contact with it. Its structure is unknown.

The living chamber has diameters at its base of 19.5 mm. and 17.5 mm. and is 20 mm. in length. At the point of greatest gibbosity the diameters are 20.7 mm. and 18.4 mm. This is located 12 mm. above the base. The constriction which precedes the aperture begins 4 mm. beyond the point of greatest gibbosity. At the aperture the diameters are 14 mm. and 18.2 mm.

The aperture appears to be nearly circular except for the small rounded hyponomic sinus, and is slightly transverse. The shell bears poorly defined longitudinal liræ of which there are three to five in the width of 1 mm.

Discussion.—The similarity of the aperture to *Verticoceras conradi,* together with the similarity of the living chamber to that of *Gomphoceras clavatum* which is endogastric, indicates that the apical portion is probably endogastric in spite of the greater convexity of the ventral outline of the living chamber.

Type.—Holotype, New York State Museum, no. 12635/1.

Occurrence.—In the Cherry Valley limestone at Schoharie.

Verticoceras sp. Pl. 6, fig. 6.

Associated with the holotype of *Verticoceras erectum* there was a portion of a smaller brevicone with an incomplete living chamber. The adapertural five cameræ of the phragmocone of this were preserved in part.

The phragmocone is 8 mm. in length, and bears sutures which appear to be straight and transverse. The cameræ measure 2.5, 2.6, 2.6 and .5 mm. respectively in depth.

The fragment of the living chamber is 18 mm. in length and measures 17.2 mm. in dorso-ventral diameter at the base. This increases to 19.2 mm. 8.3 mm. farther up. At a point 3 mm. farther the diameter contracts to 17 mm.

This is obviously a mature specimen, and the apparently erect condition, the slight rate of expansion of the phragmocone, and the character of the vertical outline of the living chamber indicate that it is very closely related to *Verticoceras erectum* from which it is separated mainly by its smaller size. It is possible that this specimen should be regarded as a dwarfed form of *V. erectum,* and it is not impossible that the differences in size might be due to differences between the sexes.

Type.—New York State Museum, no. 12625/1.

Occurrence.—In the Cherry Valley limestone at Schoharie.

Verticoceras conradi (Hall)

Gomphoceras (*Apioceras*) *Conradi* Hall, J., 1860, 13th Report New York State Cab. Nat. Hist., p. 106.
Gomphoceras (*Apioceras*) *Conradi* Hall., J., 1862, 15th Rep. New York State Cab. Nat. Hist., pl. 8, fig. 8.
Cyrtoceras Conradi, Hall, J., 1876, Illustrations of Devonian Fossils: Cephalopoda, pl. 47, fig. 1-2 (not 11.)
Gomphoceras Conradi, Hall, J., 1879, Paleontology of New York, vol. 5, pt. 2, p. 348, pl. 46, fig. 1-2, (not fig. 3.)

Section nearly circular in the young, slightly depressed in the ephebic portion. The phragmocone is slightly curved endogastrically, but the curvature is not as pronounced as is indicated in Hall's figure. The section at the base of the lectotype is about 6 mm. both dorso-ventrally and transversely. The length of the phragmocone measured along the ventral outline is 14 mm. as nearly as can be told, and 16 mm. on the dorsum. In this length the dorso-ventral diameter has increased to 12.0 mm. and the transverse diameter has increased to 13.5 mm. The only suture exposed is that at the base of the living chamber. It is straight and transverse.

The living chamber is 14 mm. in length. 3.5 mm. above the base the diameters have increased to 12.7 mm. and 14.9 mm. In the remaining length there is a gradual contraction toward the aperture which is 10 mm. dorso-ventrally and 12 mm. in transverse diameter. The aperture bears a low broad dorsal crest, lateral sinuses, ventro-lateral crests and a rounded hyponomic sinus which is 3.5 mm. across and 2.75 mm. in length.

The surface of the shell bears obscure lines of growth.

The siphuncle is not exposed in this specimen, but is probably close to the ventral side.

Discussion.—The small size and the slight rate of expansion are distinctive specific characters. The venter is less gibbous on the living chamber than that of *V. erectum,* and the phragmocone is more distinctly curved.

The specimen seems to be mature, for at the base of the living chamber there is an "impressed zone" which here, as in most other instances among the brevicones, seems to represent the last camera and septum in which the walls of the shell are slightly thickened internally and in which the last septum is thin or else incomplete.

Types.—Holotype; American Museum of Natural History, no. 4412/1, first specimen, type of Pal. N. Y. vol. 5, pt. 2, pl. 46, fig. 1-2; not the type of fig. 3. Though technically this is a lectotype, it appears to be a holotype by monotypy.

"Oncoceras" dilatatum Hall

Oncoceras dilatatum Hall, J., 1861, 13th Rep. New York State Cab. Nat. Hist., p. 105.

Hall described this species as follows:

> Shell very rapidly expanding toward the aperture, outer septa very moderately convex, distant about one-eighth of an inch; section oval, a little wider on the dorsal side of the transverse diameter; vertical and transverse diameters about as seven is to thirteen. The expansion at the sides in the length of five septa is from seven eighths of an inch to one and three-eighths inches, and from the dorsum to the ventral side the expansion in the same length is from one and one-eighth to one and six-eighths inches. The expansion is mainly on the dorsal side. The specimen is imperfect, and the apex and the outer chamber are unknown. The general form, shallow chambers and other characters refer it to the genus *Oncoceras.* The curvature of the body of the shell has been very moderate, as usual with the shells of this genus.
>
> Geologic formation and locality: In the Goniatite limestone at Schoharie.

Hall's specimen was not figured, and no further mention seems to have been made of this species in his later works. It is certainly a breviconic form, and seems to represent a portion of the phragmocone of a very large form. It would appear from the description that this might be either *Acleistoceras fischeri* or *Poteriocerina solidum.* Hall's specimen appears to have been lost; evidently Hall attached little importance to it, for he failed to figure it or even to mention it in the Paleontology of New York. No specimens can be referred to this species with certainty, and the species is probably included with one of the large breviconic forms mentioned above.

Type.—Unknown; probably lost.

AGONIATITES Meek

A complete discussion of this genus will be found in Dr. A. K. Miller's monograph of the Devonian Ammonoidea, which is still in press[61]. For the sake of completeness we include a brief summary of the species of the Cherry Valley limestone, together with the description of one new species.

Hall described *Agoniatites vanuxemi,* which has erroneously been mentioned in the introductory portions of this paper under the specific name given it by Vanuxem, *expansus.* This name was preoccupied. This is the most abundant cephalopod in the Cherry Valley limestone throughout the greater part part of its extent. *Agoniatites nodiferus* (Hall) was described as a variety of *A. vanuxemi,* but is being regarded as a distinct species by Miller[61]. *A vanuxemi* may be recognized by the absence of spines or nodes on the surface of the shell. *A nodiferis* is known only from a layer of shales at Cherry Valley which was formerly thought to lie some distance below the Cherry Valley horizon. According to Cooper[8] the limestones above this shale is the typical Cherry Valley, and it is probable that this shale member is a very local phenomenon, representing a lens between the two layers of limestone.

A. floweri Miller, in manuscript, is characterized by the formation of spines along the umbilical angles.

Agoniatites intermedius Flower, sp. nov. Pl. 1, fig. 11.

The holotype represents a large mature conch. Only the right side is preserved, a fragment bearing the ventral two-thirds of the aperture is missing, and only one of the sutures is preserved; this appears to be the one at the base of the living chamber.

---

[61] June. 1936. (Personal Correspondence.)

The section of the whorl, the formation of the sutures and the direction of the striæ on the surface of the shell show no difference between this species and *A. vanuxemi.*

The conch is characterized by nodes which appear on the interior as well as on the exterior. These are arranged in two series as follows:

First series, on the umbilical shoulder; the homologues of similar irregularities in *A. nodiferis,* and the spines in *A floweri.*

1. A broad rounded node of rather irregular shape about 10 mm. across, where the height of the whorl is about 85 mm.

2. A similar though slightly smaller protuberance 10 mm. beyond the first. Height of whorl 105 mm.

Second series; the homologúes of the nodes of *A. nodiferis.* There are five nodes in this series. They vary in clarity, the second and third being the clearest, and the fourth and fifth progressively lower and more obscure adaperturally. The nodes are about one-third the distance from the umbilical shoulder to the abdominal angles, and occur only in the region of greatest transverse diameter. The apices are located about 35 mm. apart. The first occurs where the height of the whorl is 115 mm. and they are regularly spaces to the aperture, where the height of the whorl is estimated as about 170 mm.

Comparison with a specimen of *A. vanuxemi* which showed the protoconch indicates that nodes appear on the middle of the fifth whorl. The similar structures in *A. nodiferis* occur just beyond the end of the third whorl. Intermediate stages are not known. In a series of specimens of *A. nodiferis,* only slight variation in the appearance of the nodes was found, though they varied greatly in clarity owning to compression in the shales.

Type.—Holotype: Pal. Res. Inst., no. 5369.

Occurrence.—In the Cherry Valley limestone, at Union Springs, Cayuga county. Collected by the author.

Anaptychus of **Agoniatites vanuxemi** (?) Pl. 1, fig. 10.

One specimen from the Cherry Valley limestone appears to belong to this group of fossil forms which show the closest affinities to the carapaces of the discinocarid Crustacea, but which, on account of their frequent association with ammonoids, have been described as anaptychi. This is known from a single incomplete specimen, and is referred to *Agoniatites vanuxemi* because that is the commonest species. It cannot belong to *Parodiceras,* which is also found occasionally in the limestone, for it is too large for that form, at least too large to fit the aperture of the Cherry Valley specimens, which are generally considerably smaller than those of the Hamilton shales. That this is the only specimen known and that *Agoniatites vanuxemi* is very abundant cannot be used as an argument against the ammonoid nature of this fossil, for it represents an extremely thin, and apparently a very fragile structure, which could be preserved only under the most fortuitous circumstances.

Description.—Probably a single bilaterally symmetrical plate. Only one side is known, and the median portion is not preserved. Along the left margin, as the specimen is oriented in pl. 1, fig. 10, there is a marginal carina, which curves downward along the lateral upper margin to the posterior angle. The oblique lower margin is without any carina. The surface is smooth, but bears a series of concentric undulations, of which the inner ones are evenly rounded on the anterior-lateral portion, while the outer ones are more angulate there. The specimen is 25 mm. in length and has a greatest width of 12 mm. The plate was apparently carbonaceous or chitinous, and was very thin.

Type.—Holotype: Pal. Res. Inst., no. 5370.

Occurrence.—In the Cherry Valley limestone at Stockbridge, Madison County .

EXPLANATION OF PLATES

(All figures approximately natural size unless otherwise indicated.)

PLATE I

EXPLANATION OF PLATE 1

Figure Page

1. **Michelinoceras swarthi** Flower, sp. nov. 18
Holotype, Pal. Res. Inst., no. 5332.
Cherry Valley limestone, Union Springs, N. Y.

2. **Michelinoceras swarthi** Flower, sp. nov. 18
Paratype, living chamber of a smaller specimen. Pal. Res. Inst., no. 5333.
Cherry Valley limestone, Union Springs, N. Y.

3. **Michelinoceras swarthi** Flower, sp. nov. 18
Paratype, portion of the surface from an early part of the phragmocone, about x 3. Pal. Res. Inst., no. 5334.
Cherry Valley limestone, Stockbridge, N. Y.

4. **Spyroceras** cf. **nuntium** (Hall) 27
Plesiotype, lateral aspect, slightly less than x 2. Jewett Coll., Cornell Univ., no. 7962.
Cherry Valley limestone, Cazenovia, N. Y.

5. **Diagoceras aptum** (Hall) 23
Hypotype, lateral aspect. Pal. Res. Inst., no. 5337.
Cherry Valley limestone, Union Springs, N. Y.

6. **Diagoceras aptum** (Hall) 23
Hypotype, section showing the depressed condition of the early portion of the conch. Pal. Res. Inst., no. 5338.
Cherry Valley limestone, Stockbridge, N. Y.

7. **Diagoceras aptum** (Hall) 23
Apical aspect of the specimen shown in fig. 5.

8. **Diagoceras aptum** (Hall) 23
Drawing of two consecutive septa from a polished section of an adapical portion of the specimen illustrated in figure 5, showing the outline of the siphuncle and the circumferential deposits.

9. **Spyroceras geneva** Clarke 26
Plesiotype, x 3. Jewett coll., Cornell Univ., no. 8194.
Cherry Valley limestone, Cherry Valley, N. Y.

10. Anaptychus of **Agoniatites vanuxemi** (?) 77
Pal. Res. Inst., no. 5369.
Cherry Valley limestone, Stockbridge, N. Y.

11. **Agoniatites intermedius** Flower, sp. nov. 76
Holotype, lateral aspect, slightly less than one half natural size. Pal. Res. Inst., no. 5370.

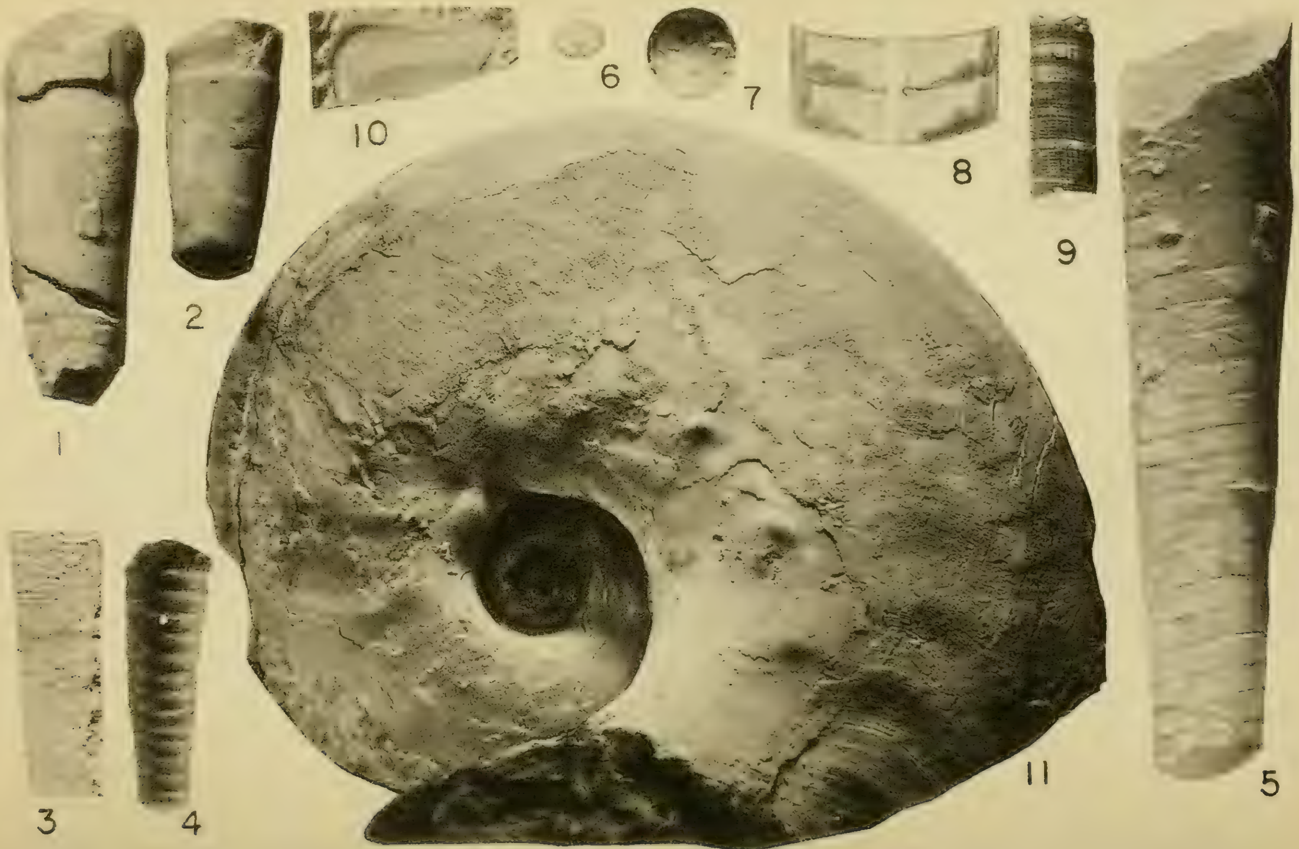

1
2
10
6
7
8
9
11
5
3
4

PLATE II

EXPLANATION OF PLATE 2

Figure Page

1. **Diagoceras aptum** (Hall) 23
Holotype, lateral aspect. New York State Museum no. 12345/1. Courtesy of the New York State Museum, Albany, N. Y., U. S. A.
Cherry Valley limestone, Schoharie, N. Y.

2. **Striacoceras typum** (Saemann) 29
Portion of phragmocone showing the failure to deposit a septum. Pal. Res. Inst., no. 5355.
Cherry Valley limestone, Stockbridge, N. Y.

3. **Striacoceras typum** (Saemann) 29
Natural section of phragmocone showing the circumferential deposits and the siphuncle. Pal. Res. Inst., no. 5351.

4. **Palmeroceras fustis** (Hall) 59
Portion of surface of the holotype, x 3. New York State Museum, no. 12371/1. Courtesy of the New York State Museum.

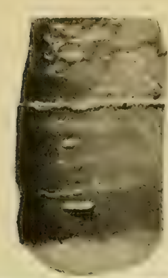
5. **Striacoceras kionoceroides** Flower, sp. nov. 40
Portion of the surface of the holotype, x 4. Pal. Res. Inst., no. 5361.
Cherry Valley limestone, Stockbridge, N. Y.

6. **Striacoceras typum** (Saemann) 29
Gerontic ornament, x 4. Pal. Res. Inst., no. 5359.
Cherry Valley limestone, Stockbridge, N. Y.

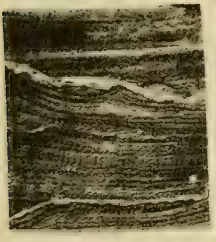
7. **Striacoceras typum** (Saemann) 29, 32
Paratype, portion of surface x 3. New York State Museum, no. 12381/1. Courtesy of the New York State Museum.
Cherry Valley limestone, Manlius, N. Y.

8. **Tetranodoceras transversum** (Hall) 42
Lectotype, ventral aspect, x ½. New York State Museum, no. 12226/1. Courtesy of the New York State Museum.
Cherry Valley limestone, Manlius, N. Y.

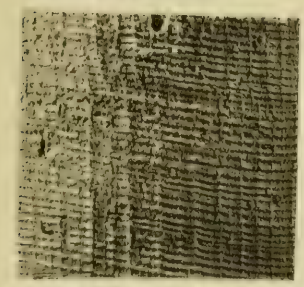
9. **Striacoceras typum** (Saemann) 29, 32
Plesiotype, ventro-lateral aspect, x ½, showing abnormal sutures.
Cherry Valley limestone, Stockbridge, N. Y.



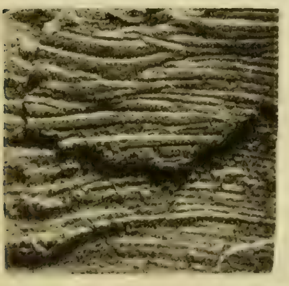
2



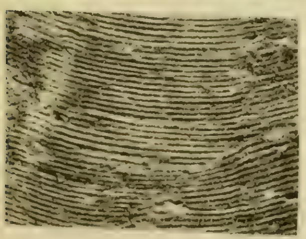
4



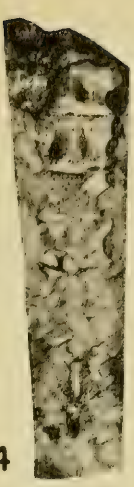
5



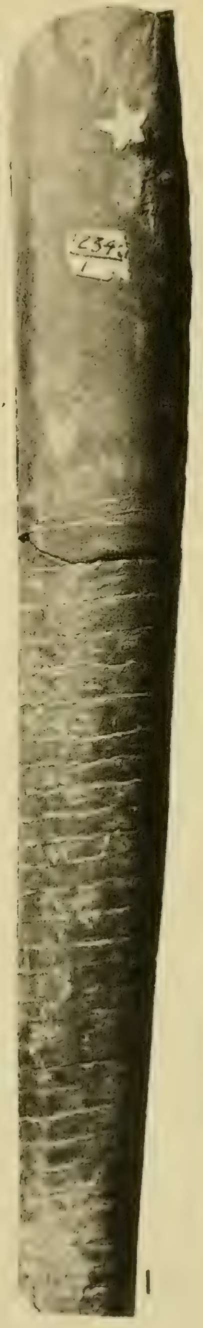
6



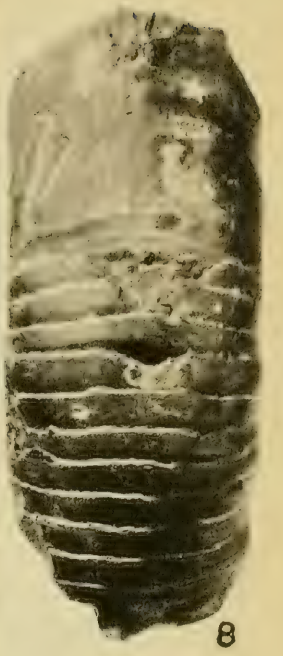
7



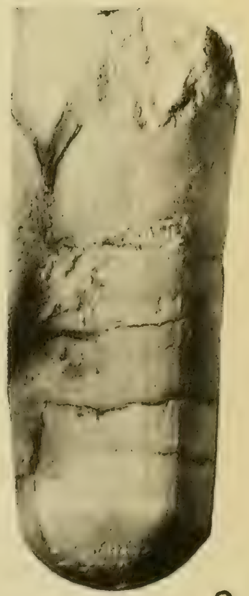
3



1



8



9

PLATE III

EXPLANATION OF PLATE 3

Figure Page

1. **Striacoceras typum** variant **gamma,** new varriant 38
Holotype, lateral aspect, x ½. Pal. Res. Inst., no. 5345.
Cherry Valley limestone, Stockbridge, N. Y.

2. **Striacoceras typum** variant **alpha,** new variant 35
Paratype, ventral aspect, x ½. Pal. Res. Inst., no. 5341.
Cherry Valley limestone, Union Springs, N. Y.

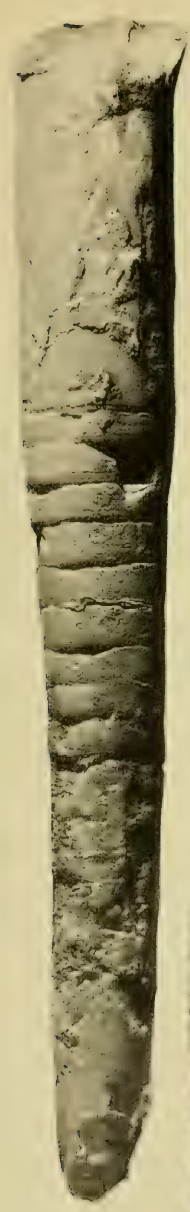
3. **Striacoceras typum** variant **beta,** new variant 37
Plesiotype, ventral aspect of internal mold showing outline of the circumferential deposits. Pal. Res. Inst., no. 5348.
Cherry Valley limestone, Stockbridge, N. Y.

4. **Striacoceras typum** variant **beta,** new variant 37
Plesiotype, lateral aspect, x ½, showing the relation of the development of the internal deposits to the living chamber. Pal. Res. Inst., no. 5349.
Cherry Valley limestone, Stockbridge, N. Y.

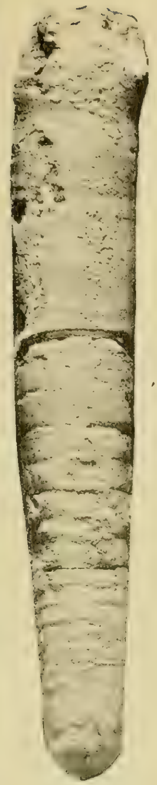
5. **Striacoceras typum** variant **beta,** new variant 37
Ventral aspect of the apical portion of the same specimen, x 1.

6. **Striacoceras typum,** variant **delta,** new variant 39
Lateral aspect of the phragmocone of the holotype. Pal. Res. Inst., no. 5346.
Cherry Valley limestone, Stockbridge, N. Y.

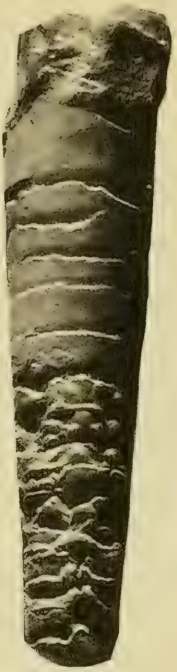
7. **Striacoceras typum** variant **beta** (?) 37
Plesiotype, showing the characteristic surface of the internal mold where circumferential deposits are only slightly developed. ventral aspect. Pal. Res. Inst., no. 5350.
Cherry Valley limestone, Stockbridge, N. Y.



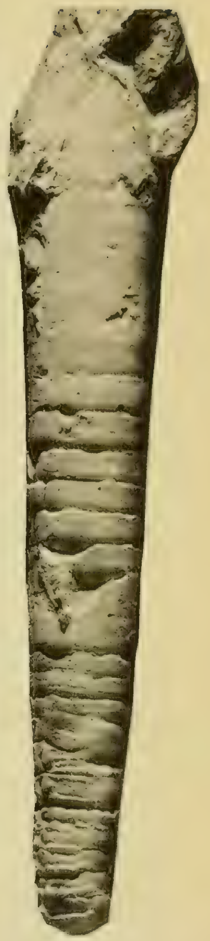
1



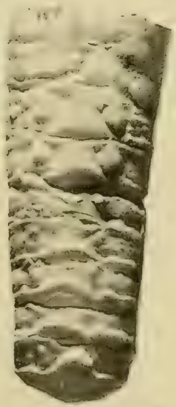
2



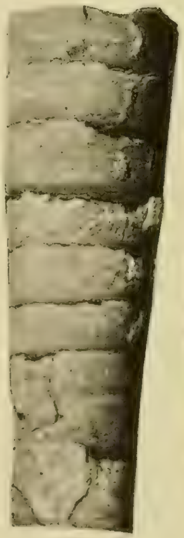
3



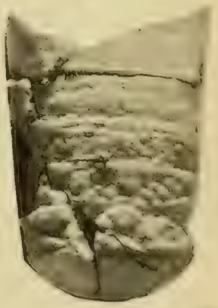
4



5



6



7

PLATE IV

EXPLANATION OF PLATE 4

Figure Page

1. **Palmeroceras fustis** (Hall) 59

   Drawing of longitudinal section of the siphuncle. Based on the holotype, New York State Museum, no. 12371/1.
   Cherry Valley limestone, Manlius, N. Y.

2. **Palmeroceras fustis** (Hall) 59

   Dorsal aspect of adapical portion of holotype showing the sectioned siphuncle. Courtesy of the New York State Museum, Albany, N. Y., U. S. A.

3. **Striacoceras typum** (Saemann) 29

   Natural section showing the characteristic cyrtochoanitic aspect of the siphuncle. Pal. Res. Inst., no. 5372.
   Cherry Valley limestone, Stockbridge, N. Y.

4. **Striacoceras typum** (Saemann) 29

   Adapical aspect of a normal septum. Pal. Res. Inst., no. 5360.
   Cherry Valley limestone, Stockbridge, N. Y.

5. **Casteroceras alternatum** (Hall) 47

   Ventral aspect of a hypotype; the holotype of *Thoracoceras wilsoni* Clarke. New York State Museum, no. 12520/1. Courtesy New York State Museum.
   Cherry Valley limestone, Manlius, N. Y.

6. **Ovoceras (?) gibbosum** (Hall) 68

   Adapertural aspect of hypotype showing a portion of the aperture. Pal. Res. Inst., no. 5367.
   Cherry Valley limestone, Stockbridge, N. Y.

7. **Striacoceras typum** variant **beta,** new variant 37

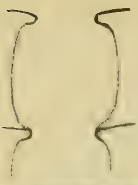
   Holotype, ventral aspect, x ½. Pal. Res. Inst., no. 5343.
   Cherry Valley limestone, Stockbridge, N. Y.

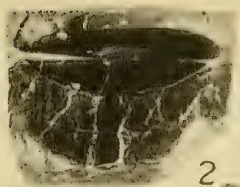
8. **Striacoceras typum** variant **alpha,** new variant 35

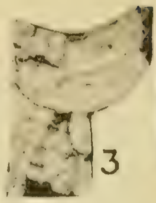
   Holotype, ventral aspect, x ½. Pal. Res. Inst., no. 5340.
   Cherry Valley limestone, Union Springs, N. Y.

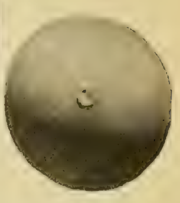
9. **Striacoceras typum,** variant **gamma,** new variant 38

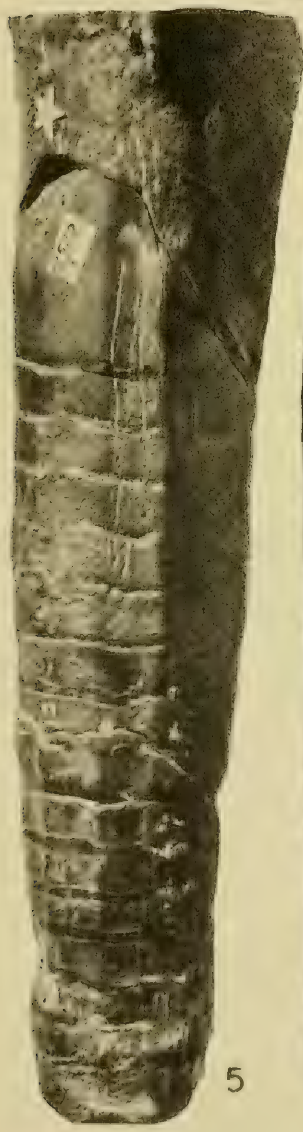
   Holotype, lateral aspect, x ½. Same specimen as pl. 2, fig. 7. Courtesy New York State Museum.
   Cherry Valley limestone, Falls of Oneida Creek, N. Y.

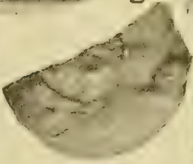

1

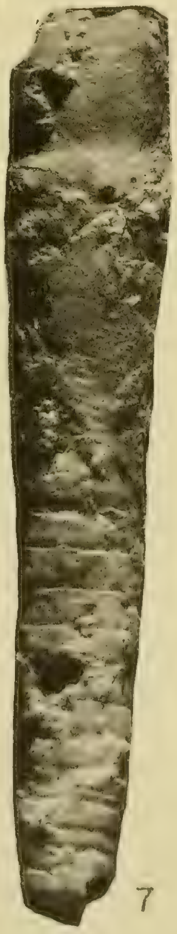

2

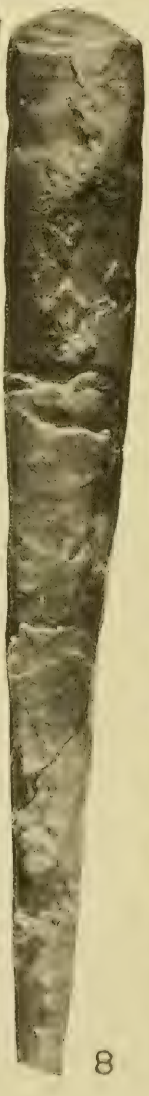

3


4


5


6


7


8

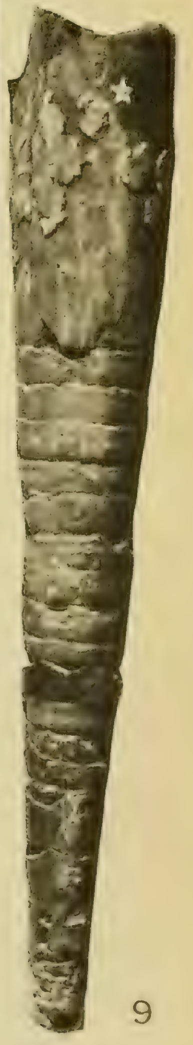

9

PLATE V

EXPLANATION OF PLATE 5

Figure Page

1. **Striacoceras typum** (Saemann) 29

Portion of the ephebic surface, about x 3. Pal. Res. Inst., no. 5358.

Cherry Valley limestone, Stockbridge, N. Y.

2. **Casteroceras alternatum** (Hall) 47

Ventral aspect of holotype. New York Staet Museum, no. 12101/1. Courtesy New York State Museum.

Cherry Valley limestone, Schoharie, N. Y.

3. **Casteroceras alternatum** (Hall) 47

Figures 1-5 and 8-11 were furnished by the New York State Museum, Albany, N. Y., U. S. A.

Hypotype, ventral aspect, showing section through the siphuncle in the upper portion. Slightly greater than natural size. Cornell collection. Uncatalogued.

Cherry Valley limestone, Manlius, N. Y.

4. **Casteroceras alternatum** (Hall) 47

Hypotype, lateral aspect, very slightly less than x 1, showing gerontic living chamber, internal mold, and fragments of the shell. Pal. Res. Inst., no. 5363.

Cherry Valley limestone, Stockbridge, N. Y.

5. **Casteroceras alternatum** (Hall) 47

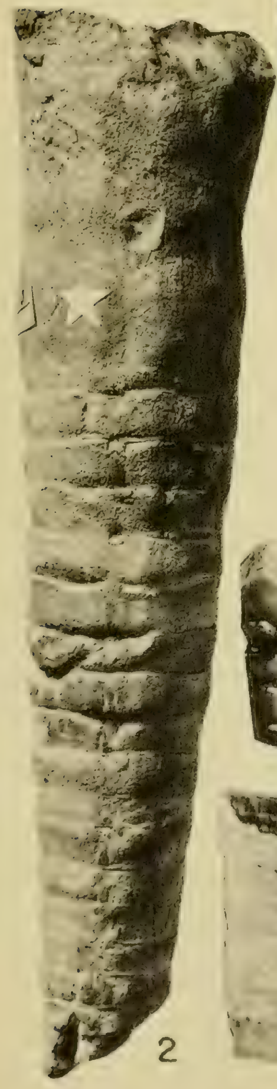
Ventral aspect of the same specimen.

6. **Striacoceras typum** variant **epsilon,** new variant 39

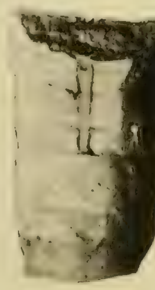
Ventral aspect of holotype. Pal. Res. Inst., no. 5347.

Cherry Valley limestone, Stockbridge, N. Y.

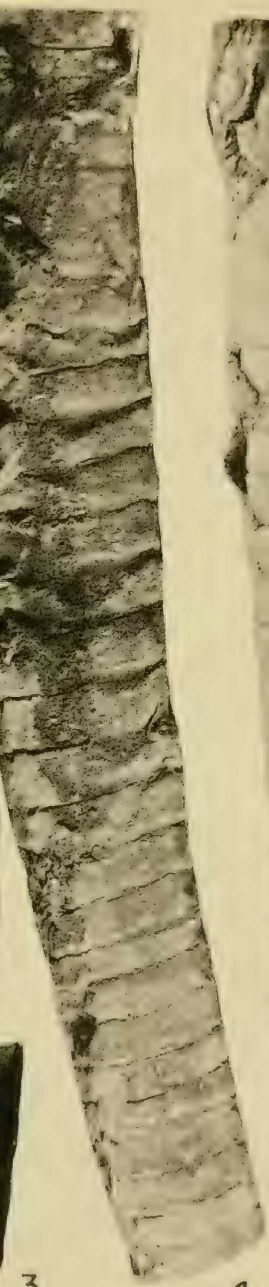
1



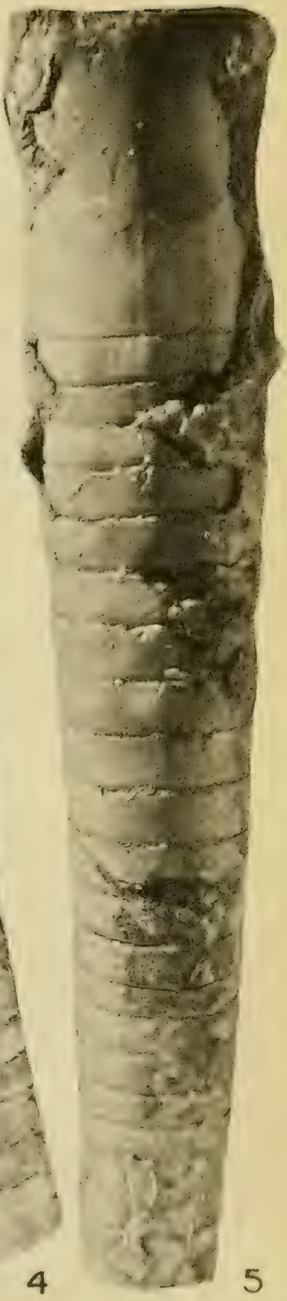
2



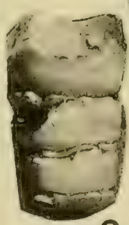
3



4



5

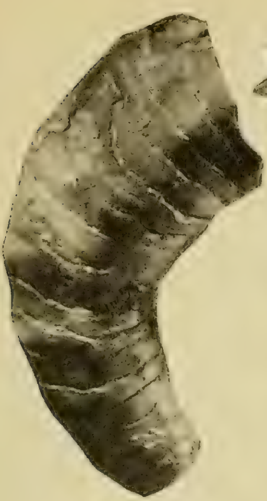


6

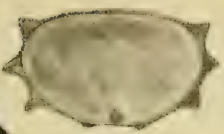
PLATE VI

EXPLANATION OF PLATE 6

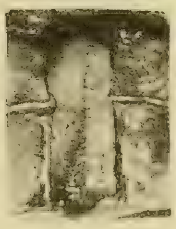
Figure		Page
1.	**Tetranodoceras transversum** (Hall) Lateral aspect of a portion of the hypotype, showing the distribution of the nodes. Pal. Res. Inst., no. 5365. *Cherry Valley limestone, Stockbridge, N. Y.*	42
2.	**Tetranodoceras transversum** (Hall) Diagramatic cross section through a nodose ring; based on the same specimen.	42
3.	**Tetranodoceras transversum** (Hall) Section through the siphuncle, ventral aspect, about x 2, from the same specimen.	42
4.	**Tetranodoceras transversum** (Hall) Ventral aspect of a paratype, showing the aperture, x ½. Pal. Res. Inst., no. 5366. *Cherry Valley limestone, Stockbridge, N. Y.*	42
5.	**Tetranodoceras transversum** (Hall) Lateral aspect of specimen represented in figs. 1-3, slightly less than natural size.	42
6.	**Verticoceras** sp. Lateral aspect, venter on left. New York State Museum, no. 12625/1. Courtesy New York State Museum. *Cherry Valley limestone, Schoharie, N. Y.*	73
7.	**Striacoceras typum** variant **alpha**, new variant Paratype, lateral aspect, showing siphuncle and oblique sutures. Pal. Res. Inst., no. 5342. *Cherry Valley limestone, Union Springs, N. Y.*	35



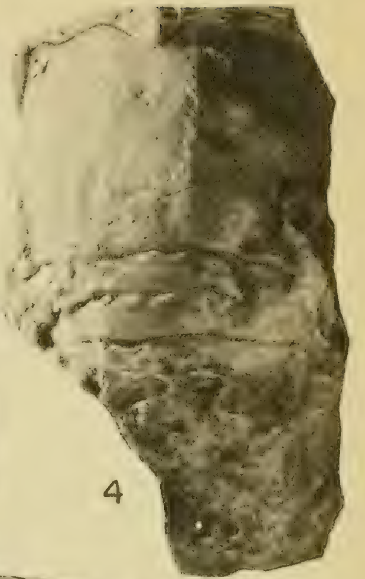
1



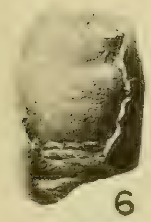
2



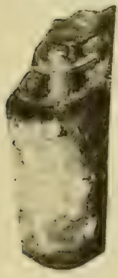
3



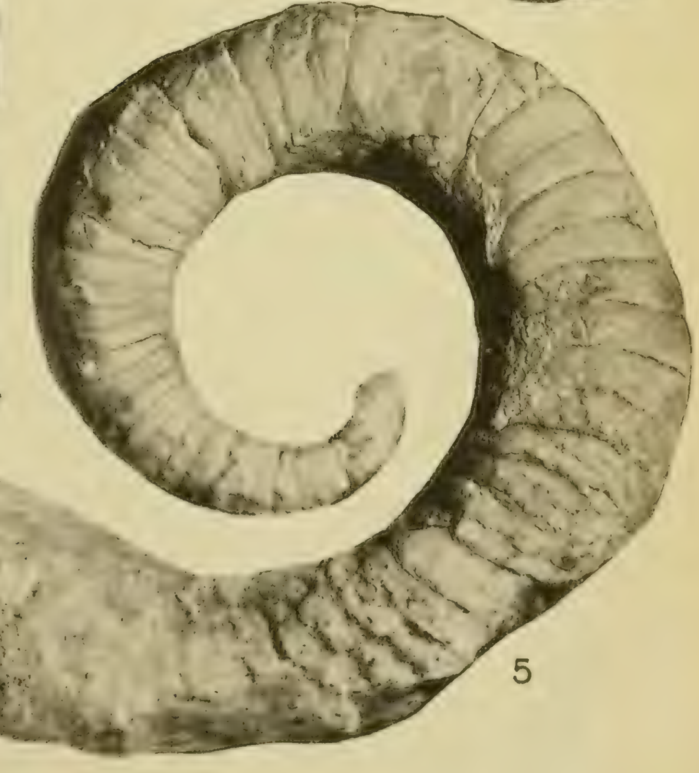
4



6



7



5

PLATE VII

EXPLANATION OF PLATE 7

Figure Page

1. **Tetranodoceras transversum** (Hall) 42

   A reconstruction of the surface based upon Pal. Res. Inst., nos. 5365, 5366. Drawn by Mrs. K. E. Caster.

2. **Striacoceras typum** (Saemann) 29

   Longitudinal dorso-ventral section of an early portion of the phragmocone showing the internal deposits. Slightly less than x 2. Considerably retouched. Pal. Res. Inst., no. 5352.

   Cherry Valley limestone, Union Springs, N. Y.

3. **Palmeroceras fustis** (Hall) 59

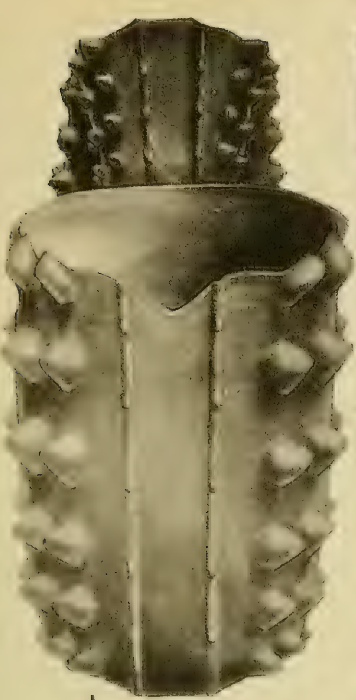
   Ventral aspect of the holotype. New York State Museum, no 12371. Courtesy New York State Museum.

   Cherry Valley limestone, Schoharie, N. Y.

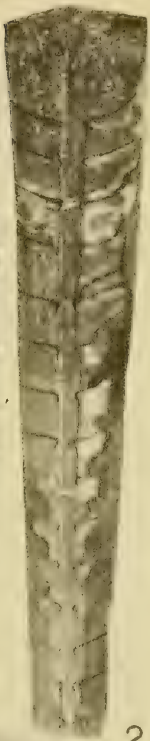
4. **Centroceras marcellense** (Vanuxem) 56

   Lateral aspect of one of Hall's hypotypes. New York State Museum, no. 12327/1. Courtesy New York State Museum.

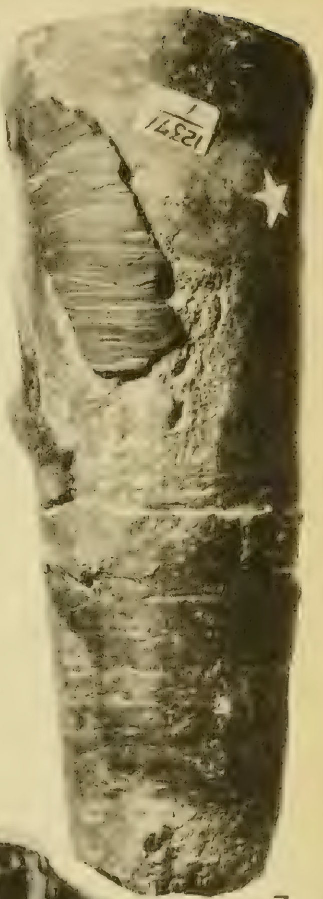
   Cherry Valley limestone, Manlius, N. Y.



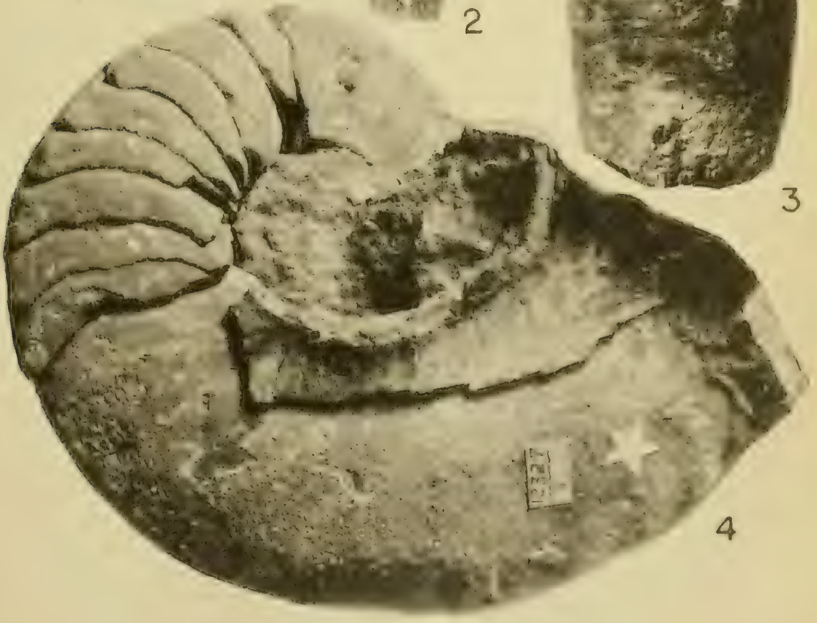
1



2



3

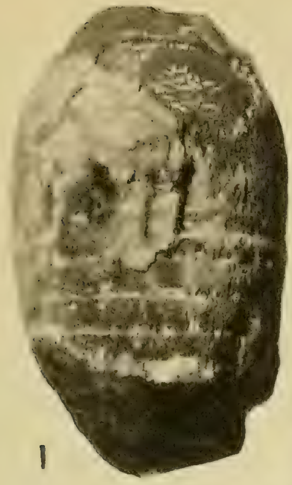


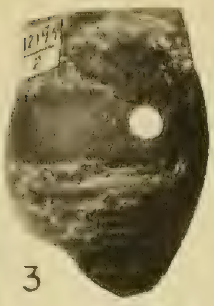
4

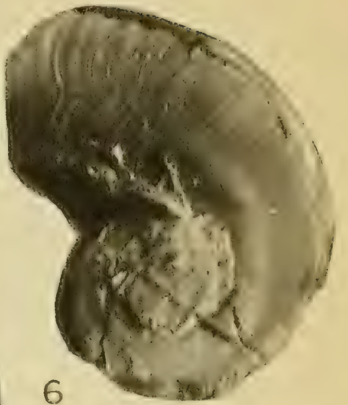
PLATE VIII

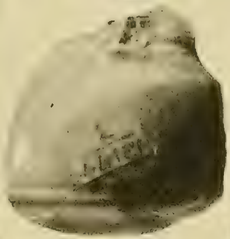
EXPLANATION OF PLATE 8

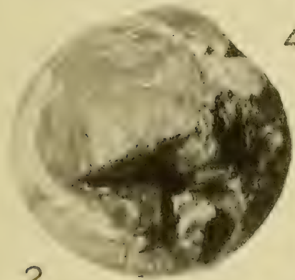
Figure		Page
1.	**Ovoceras oviforme** (Hall) Dorsal aspect of the lectotype. New York State Museum, no. 12194/1. *Cherry Valley limestone, Schoharie, N. Y.*	65
2.	**Ovoceras oviforme** (Hall) Adapertural aspect of the same specimen showing the aperture.	65
3.	**Ovoceras (?) gibbosum** (Hall) Lateral (?) aspect of the holotype. New York State Museum, no. 12194/2. *Cherry Valley limestone, Schoharie, N. Y.*	68
4.	**Ovoceras constrictum** Flower, sp. nov. Ventral aspect of the holotype. New York State Museum, no. 12194/3. *Cherry Valley limestone, Manlius, N. Y.*	66
5.	**Ovoceras constrictum** Flower, sp. nov. Adapertural aspect of the same specimen.	66
6.	**Centroceras marcellense** (Vanuxem) Lateral aspect of the inner whorls of a plesiotype, showing the ornament. Pal. Res. Inst., no. 5371. *Cherry Valley limestone, Stockbridge, N. Y.*	56
7.	**Striacoceras typum** (Saemann) Enlargement of the surface of an early portion of the shell, showing the Protokionoceroid condition, about x 4. Pal. Res. Inst., no. 5357. *Cherry Valley limestone, Union Springs, N. Y.*	29
8.	**Acleistoceras fischeri** (Hall) Enlargement of a portion of the surface of the hypotype, x 3. New York State Museum, no. 1200d/1. *Cherry Valley limestone, Manlius, N. Y.*	62
9.	**Acleistoceras fischeri** (Hall) Lateral aspect of the same specimen, x ½.	62
10.	**Aclestoceras fischeri** (Hall) Ventro-lateral aspect. The left side of the specimen is not preserved; but a trace of the shallow hyponomic sinus is shown at the left. Same specimen; x ½.	62
11.	**Ovoceras constrictum** Flower, sp. nov. Lateral aspect of a paratype. New York State Museum, no. 12438m/1. *Cherry Valley limestone, Manlius, N. Y.*	66

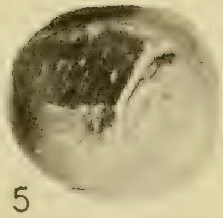

1

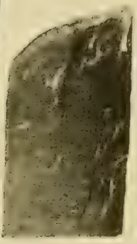

3

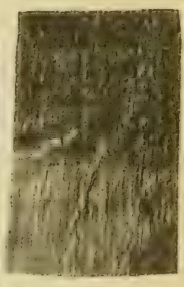

6

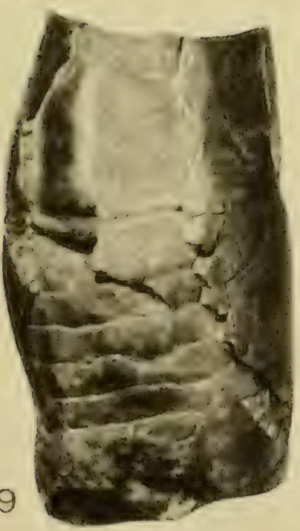

4

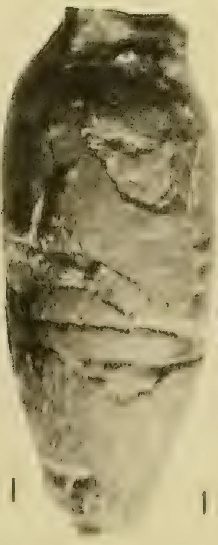

2


5


7


8


9


11

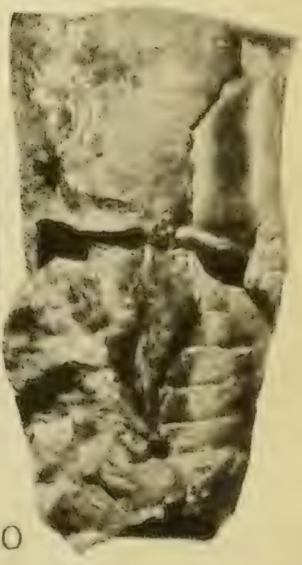

10

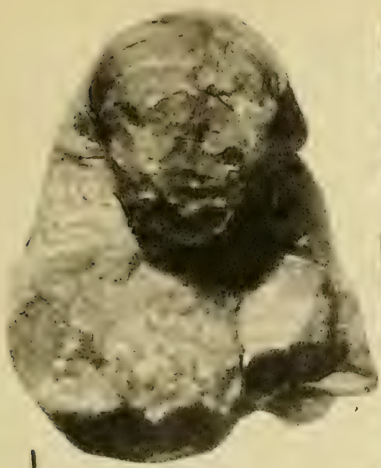
PLATE IX

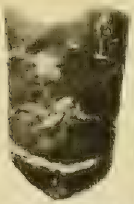
EXPLANATION OF PLATE 9

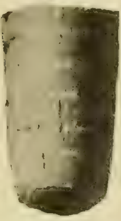
Figure — Page

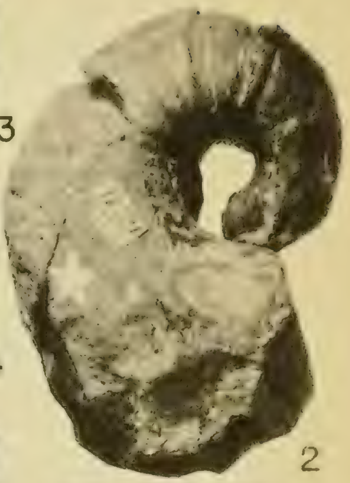
1. **Nephriticeras bucinum** (Hall) — 52
   Adapertural aspect of the holotype. New York State Museum, no. 12321/1.
   Cherry Valley limestone, Manlius, N. Y.
2. **Nephriticeras bucinum** (Hall) — 52
   Lateral aspect of the same specimen.
3. **Striacoceras typum** variant **epsilon,** new variant — 39
   Ventral aspect of a paratype. New York State Museum, no. 12381/4.
   Cherry Valley limestone, Manlius, N. Y.
4. **Striacoceras typum** (Saemann) — 29
   Dorsal aspect of a portion of the phragmocone showing the dorsal carina. Pal. Res. Inst., no. 5348. See pl. 3, fig. 3.
   Cherry Valley limestone, Stockbridge, N. Y.
5. **Striacoceras kionoceroides,** Flower, sp. nov. — 40
   Ventral aspect of holotype, showing ventral carina, ornament, and hyponomic sinus. See also pl. 2, fig. 5. Pal. Res. Inst., no. 5361.
   Cherry Valley limestone, Stockbridge, N. Y.
6. **Verticoceras erectum** Flower, sp. nov. — 72
   Ventral aspect of the holotype. New York State Museum, no. 12635/1.
   Cherry Valley limestone, Schoharie, N. Y.
7. **Verticoceras erectum** Flower, sp. nov. — 72
   Same specimen, lateral aspect.
8. **Poteriocerina solidum** (Hall) — 70
   Hypotype, ventral aspect, x ½. New York State Museum, no. 12437/1.
   Cherry Valley limestone, Manlius, N. Y.
9. **Poteriocerina solidum** (Hall) — 70
   Same specimen, left lateral aspect, x ½.
10. **Poteriocerina solidum** (Hall) — 70
    Same specimen, dorsal aspect, x ½.
11. **Striacoceras typum** variant **epsilon,** new variant — 39
    Adapical aspect of the same specimen shown in fig. 3, showing the peculiar markings on the septum connected with the internal deposits of the cameræ.
12. **Striacoceras typum** (Saemann) — 29, 32
    Pathological septum, adapical aspect. Pal. Res. Inst., no. 5353.
    Cherry Valley limestone, Stockbridge, N. Y.

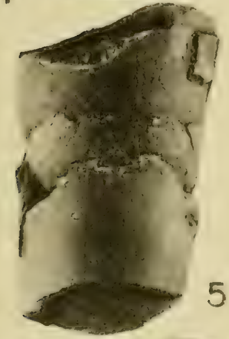
Figures 1-3 and 6-10 were furnished by courtesy of the New York State Museum, Albany, N. Y., U. S. A.

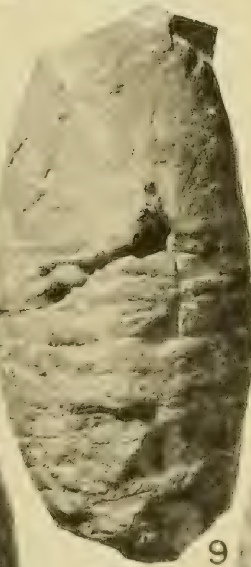

1

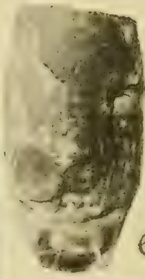

3

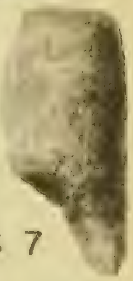

4

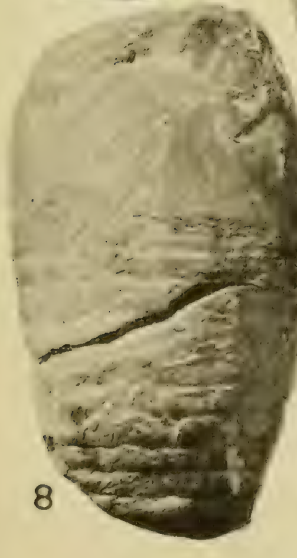

2

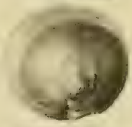

5

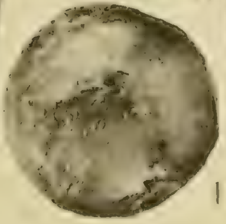

9

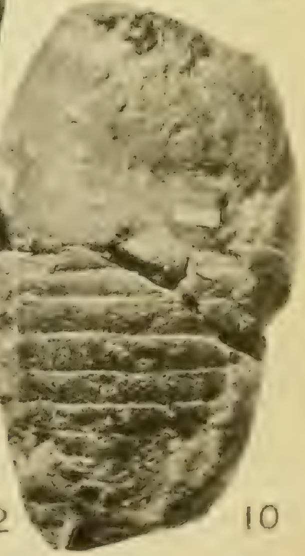

6


7


8


11


12


10

INDEX TO VOLUME XXII

Note:—Light face figures refer to the volume paging and not to the paging of the separate bulletins. Heavy face figures refer to the volume plate numbers.

A

Acleistoceras fischeri **30**, 279, 285, 331, 332
Actinosiphonata 246
Agoniatites 281, 346
  expansus 280, 346
  floweri 280
  intermedius 280
  intermedius, **23** 346
  nodiferis 276, 346
  vanuxemi 276, 283, 285, 346
Alpenoceras 285
Ammonoidea 252
Amphissites 54
  alticostatus, **4** 13, 58
  centronota, **4** 59
  confluens **4** 13, 58
  cumingsi, **3** 13, 56
  dattonensis, **4** 63
  edsoni, **4** 62
  marginiferus, **3** 13, 55
  pinguis, **4** 61
  rothi, **4** 13, 57
  rugosus, **3** 13, 54
Anadarche limestone 17
Anaptychus of Agoniatites vanuxemi (?), **23** 347
Anglicornus 248
  anneliesae, **20** 207, 249
  nasutum 250
Annulosiphonata 223
Aparchitidae 29
Ardmore basin, Pennsylvanian Ostracoda of 3
  outcrops and fossil localities, map of. Frontispiece, Bull. no. 73, Facing p. 3
Ardmorea 138
  gibberosa, **13** 139
  symmetrica, **13** 138
Arnold limestone 14

B

Bactrites clavus 280, 284
Baggina 192
Bairdia 78
  amygdaliformis, **6** 89
  ardmorensis 13, 92
  cf. ardmorensis, **7** 92
  auricula, **6** 89
  biacuta, **5** 79
  bicornis, **6** 84
  bidorsalis, **5** 81
  blaki, **6** 84
  ciscoensis ?, **7** 91
  cf. citriformis, **5** 78
  crassa, **5** 15, 80
  dornickhillensis, **5** 15, 78
  glennensis, **5** 81
  hispida, var. alta, **6** 88
  hispida, var. lesterica, **5** 88
  hoxbarensis, **6** 86
  longirostris, **6** 89
  lunata, **6** 90
  menardensis ? **6** 85
  oklahomaensis, **5** 85
  pompiloides, **6** 87
  punctata, **5** 15, 79
  warthini, **5** 15, 83
  whitesidei, **5** 15, 82
Bairdiacypris 93
  deloi, **7** 93
Bairdiidae 78
Bassler 225
Beyrichiidae 47
Bifarina 194
  tombigbeensis, **14** 194
Binodella 140
  binoda, **13** 140
Bitubulogenerina 190
  chickasawhayica, **14** 190
  xenoula, **14** 192
Blastoceras 246
  cylindrostomum, **20** 247
Bostwick member 12
Bradfield, H. H., author Bull. 73 3
Brevicones 330
Bradfordoceras 202, 209, 224, 225, 226, 228
  consortale **21** 235
  gomphoides **18** 238
  hector **17** 239, 240
  hector variant alpha n. v. **20** 241
  variant beta, n. v. **20** 242
  variant delta, n. v. **22** 243
  variant eta, n. v. **20** 245
  variant gamma, n. v. **18** 243
  variant zeta, n. v. **20** 244
  ignotum **18** 237

multicameratum **21** 234
sinuosum **19, 21** 238
transversum **17, 18, 19, 20, 22** 230
Bradyina holdenvillensis 15, 17
Bythocypris 94
angularis **7** 97
cooki **8** 97
deesensis **7** 95
frivola **8** 99
hoxbarana **8** 101
irregularis **8** 99
mytiliformis **8** 102
parallela **8** 95
pediformis **8** 100
sasakwaensis **7** 96
scapha **8** 98
simillima **7** 96
subpediformis **8** 100, 102
tomlinsoni **7** 13, 94

C

Carlloceras 209, 220
garlandensis **16** 221
Caster, K. E., co-author Bull. 75 197
Casteroceras 316
alternatum **26, 27** 279, 284, 317
erro 320
tyrelli 320
Cavellina 129
bisectata **12** 130
expansa **12** 132
laevissima **12** 133
minuta **11** 130
polita **12** 132
pulchella **12** 131
aff. pulchella **12** 131
robusta **11** 129
sp. **12** 134
subpulchella **11** 129
Cavellinella 136
casei **12** 136
Centroceras 324, 325
marcellense **29, 30** 279, 284, 326
Centroceratidae 324
Cephalopod classification 287
morphology 286
known occurrence of (in Cherry Valley limestone) 279
Cherry Valley limestone 273, 275
Chonetes mesolobus 15
Circumferential deposits 287
Confederate vs. chert conglomerate 14
Confederate-Westheimer member 16
Conostichoceras 340, 341
Corynella 35
capax **1** 35, 36
Cyathus 137
kellumi **13** 137
Cyathus marginata **13** 138
Cycloceras 209
Cytherella 122
berwynensis **10** 122
brevis **11** 124
brevisulcata **11** 123
cavellinoides **11** 124
daubeana, **11** 126
aff. gloria **11** 123
aff. gloria, var. alta n. var., **11** 128
jolliffana, **10** 122
laevis **11** 125
lirata **11** 125
ottervillica **11** 123
ottervillica var. obesa **10** 123
Cytherellidae 121
Cytheridae 73
Cyrtoceras alternatum 316, 317
hector 230
undulatum 317
Cyrtochoanites 223, 328

D

Daube limestone 18
Dawsonoceras thoas 207
Deese formation 13
Deiroceras 224
Devil's Kitchen member 13
Diadiploceras 324
Diagoceras 293
aptum **23, 24** 279, 293
Dolorthoceras 224, 225, 226
Dornick Hills formation 11

E

Ecologic notes 206
Episeptal deposits 287
Eskimoceras 224
Euloxoceras 224, 226
Euophioceras 325

F

Flower, R. H. Author Bull. 76 271
co-author Bull. 75 197
Fusulinella 15

G

Gaudryina 189
koimetercola, **14** 189
Glyptopleura 68
whitei **14** 68
Glyptopleuridae 68
Glyphioceratidae 252
Gonatocyrtoceras 340, 341
Goniatite limestone 275
Goniatites marcellensis 325
Gyroceras constrictum 312
expansum 322, 323

H

Hadley, W. H., Jr., author Bull. 74 186
Haplophragmoides ? 11
Harltonella 118
ardmorensis **10** 119
elongata **10** 120
macropleura **10** 120
robusta **10** 120
Healdia 104
Healdia alba **10** 115
aff. ampla **9** 105

angulata **9** 110
? area **9** 109
bendana **9** 107
bovicornis **9** 108
aff. bythocyproidea **9** 107
caneyensis **8** 105
cara **9** 110
carterensis **10** 111
ciscoensis **9** 113
cuneiformis **10** 113
deesensis **9** 108
ehlersi **9** 109
formosa **9** 108
cf. glennensis **9** 111
humilis **9** 112
nucleolata **10** 114
oblonga **9** 106
ovata **10** 114
simplex **10** 113
sp. **9** 106
Healdiacypris 103
perplexa **8** 103
Hillinella kellettae 15
Holinella 47
gibbosa **2** 47
cf. pulchra **2** 48
ulrichi **2** 48
Hollites 49
Homaloceras 324
Hoxbar formation 16
Hyperammina gracilis 11
Hyposeptal deposits 287

J

Jolliff limestone 12
Jonesina 38
arcuata **2** 13, 38
biformis **2** 40
daubeana **2** 41
deesensis **2** 42
dubia **3** 43
gallowayi **2** 39
gregarina **2** 42
hoxbarana **2** 40
frisulcata **2** 43

K

Kionoceratidae 295
Kirkbya 50
bendensis **3** 13, 50
cf. inornata **3** 52
jolliffana **3** 13, 51
obliqua **3** 51, 53
Kirkbyidae 49
Kirkbyina 45
Kirkbyina laevis **3** 45
Kloenellidae 38
Knightina 64
kelettae **4** 65
texana **4** 64
Koninckioceratidae 220

M

Lester limestone 13
Lewis Run sandstone member 202
Localities of Pennsylvanian Ostracods list of 141

Loxoceras 224, 226
Lyrioceras dubium 279, 322
liratum 279, 284, 321

M

Macrocypris 104
Macrocypris delicatula **8** 104
Mammoides 37
mammillata **1** 37
Massilina 189
goniopleura **14** 189
Michelinoceras 288
noveboracense 292
swarthi **23** 279, 288
uniconstrictum 290
Monoceratina 13, 74
dornickhillica **1** 13, 76
huddlei **1** 77
Monoceratina n. sp. **1** 77
Monoceratina ventralis **1** 75
Moorea 70
silurica 71
Mooreoceras 224, 225, 226
Moorites 73
minutus **5** 73

N

Nautilus inopinatus 324
Neocycloceras 210
cadwaladeri **16** 218
harrisi **16** 215
lilianae **16** 217
obliquum **15, 16** 206, 212
206, 212
var. geronticum **16** 214
Nephriticeras 321
Nephriticeras bucinum **31** 279, 284
321, 322
New genus? **13** 140
Nuferella 45
infrequens **3** 45, 46

O

"Onococeras" dilatatum 345
Oncoceratidae 246
Ophidioceratidae 324
Ophidioceras 324
Ophioceras 324
Ormoceras 224
Orthoceras breynii 224
conchleatum 230
consortale 230, 235
constrictum 290, 291
? sp? **20** 251
warrenense 230
Orthoceratidae 288
Orthoceratites nodulosus 320
Ostracoda of uncertain position 137
orientation of carapace 22
Otterville limestone 12
Ovoceras 331
Ovoceras 331, 334
constrictum **30** 280, 331, 336
(?) **26, 30** 280, 331, 338
oviforme **30** 280, 331, 335

P

Palmeroceras 328
- fustis **24, 26, 29** 279, 329

Paralegoceras 298
- milleri **22** 252
- discoideum 280, 284

Paraparchites 29
- ardmorensis **1** 34
- brazoensis **1** 32
- dornickhillicus **1** 13, 31
- elongatus **1** 32
- guthreyi **1** 31
- harltoni **1** 33
- ottervillicus **1** 13, 30, 34
- wapanuckaensis **1** 13, 30

Pennsylvanian of the Ardmore basin, diagram of section 10

Pennsylvanian Ostracoda of the Ardmore Basin 3

Pennsylvanian outcrops and fossil localities, map of. Frontispiece, Bull. no. 73, Facing 3

Poteriocerina 310
- lubosum 340, 341
- soldium **31** 280, 340

Primitiidae 35

Protokionoceras marcellense 284

Pseudorthoceras 224, 225, 226, 228, 229, 230
- knoxense 227
- palmerae **21** 227

Pseudorthoceratidae 224, 224, 223

Pumpkin Creek limestone 13

Pulvinulinella 193
- harrisi **14** 193

R

Rhadinoceratidae 320

Rhyticeratidae 311

Roundyella 66
- bellatula **4** 66

S

Sactoceras 224

Sactoceratidae 223, 224

Sansabella 44
- whitei **3** 44

Scaberina 67
- nodomarginata **4** 67

Schmidtella **13** 139

Schoharie 276

Seminolites 115
- elongatus **10** 116
- healdoides **10** 117
- kosomensis, **10** 117
- ? pushmatahensis, **10** 118
- aff. truncatus, **10** 116

Spiroloculina 191
- bidentata, **14** 191

Springer formation 9

Spyroceras 295
- crotalum 284
- geneva, **23** 284, 296
- cf. nuntium, **23** 279, 297

Stockbridge falls 276

Striacoceras 298
- kionoceroides, **24, 31** 279, 310
- typum, **24, 25, 26, 27, 28, 29, 30** 279, 282, 284, 299
- variant alpha, **25, 26, 28** 305
- variant beta, **25, 26** 307
- variant delta, **25, 26** 309
- variant epsolin, **27, 31** 309
- variant gamma, **25, 26** 208
- variants 282

Stutzring 287

Sulcella 134
- harrisi, **12** 134

T

Tetranodoceras 311
- transversum, **24, 28, 29** 279, 284, 312

Troedssonoceras 224

Turnoceras 340, 341

U

Ulrichia 53
- montosa, **3** 53

Union Dairy-Crinerville member 17

Union Springs 277
- member 275

V

Verticoceras 285, 331, 342
- conradi 280, 331, 344
- erectum, **31** 280, 331, 342

Verticoceras sp,, **28** 280, 331, 343

W

Waylandella 103
- deesensis, **8** 104

Y

Youngeilla 72
- ? convergens, **4** 72
- ? elongata, **4** 72
- ? gracilis, **4** 72

Youngiellidae 69

ERRATA

Pages 186 *et seq.* should read 173 *et seq.*

For *Neocyloceras* read *Neocycloceras,* p. 214.

Under *Neocycloceras obliquum* var. *geronticum* read 5013 for 5007, p. 258.

For No. 56 read No. 76 in captions pp. 273-288.

For *A. expansus* read *A. vanuxemi,* pp. 280-281.

For *novboracense* read *noveboracense,* p. 292.

For *inoptinatus* read *inopinatus,* p. 324.

SMITHSONIAN INSTITUTION LIBRARIES
3 9088 01358 4602